SOUHEGAN RIVER WATERSHED STUDY

Prepared by the

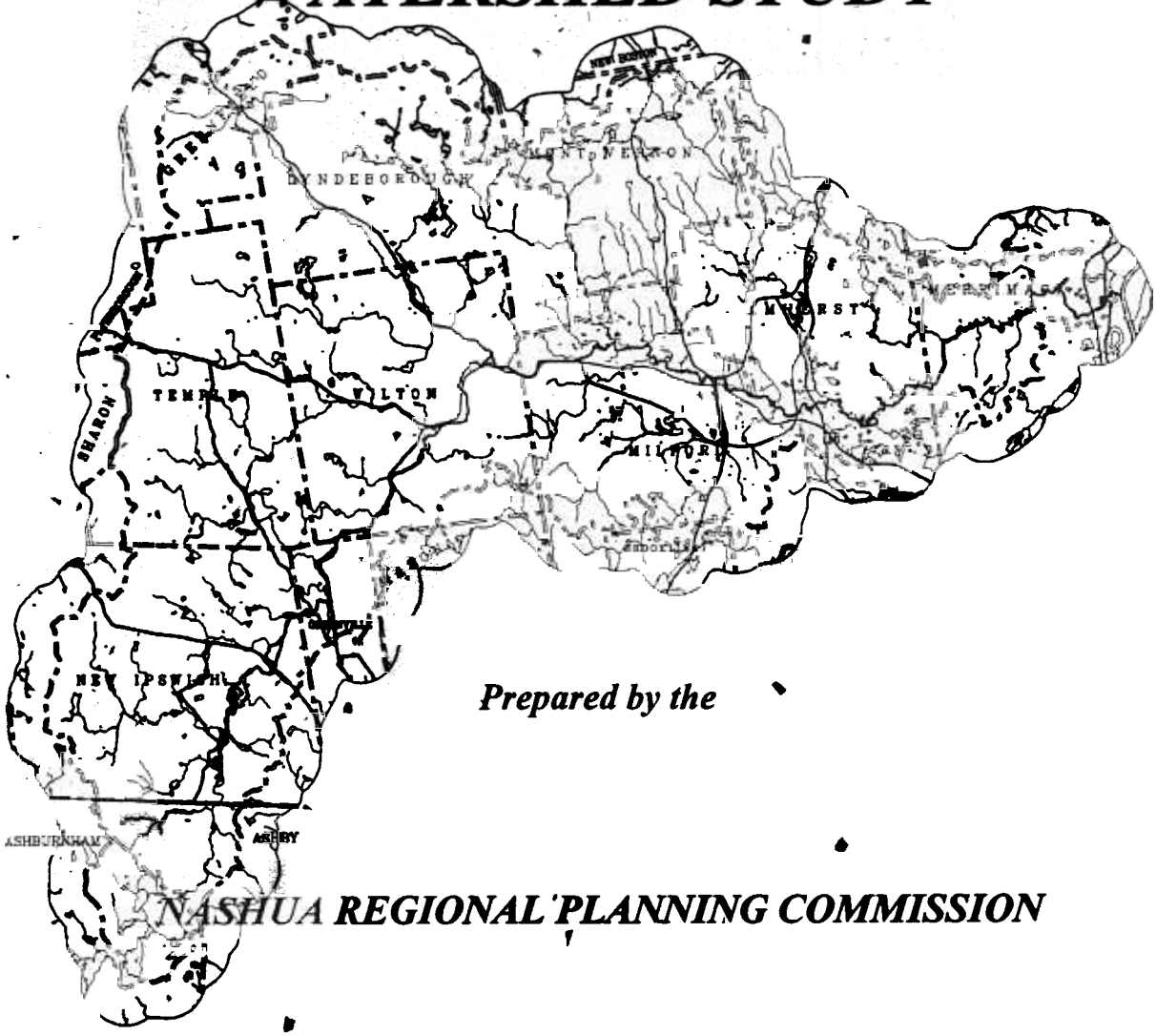
Nashua Regional Planning Commission

September 1995

This project was funded through a grant from EPA Region I (X001885) to the New England Interstate Water Pollution Control Commission (NEIWPCC) for the Merrimack River Initiative (MRI).

SOUHEGAN RIVER

WATERSHED STUDY



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NASHUA REGIONAL PLANNING COMMISSION

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INTRODUCTION

SECTION I: INTRODUCTION

In 1992, the Nashua Regional Planning Commission (NRPC) initiated a corridor study for the Souhegan River. The Corridor Study was limited to an area directly adjacent to the river, defined by major roads where possible and a 1,000 foot buffer where roads did not exist. The idea from the outset was to expand the Corridor Study to include the entire watershed as funds became available. With the assistance of the Merrimack River Initiative (MRI), a New Hampshire-Massachusetts-Environmental Protection Agency (EPA) program, the idea became a reality when the Souhegan River Watershed Study was selected as a pilot project in 1993.

The Watershed Study was conducted in two broad phases. Phase I included the collection of information on the natural and manmade characteristics of the watershed while Phase II involved an assessment of the information and the development of recommendations. The intent was to conduct the study by utilizing existing information available from various agencies and organizations in both states. The existing information was utilized to assess differing characteristics such as using the soils information to evaluate topography, wetlands, floodplains and septic system capability.

Phase I began with a meeting of the varied interest groups within the watershed to identify the uses and values of the Souhegan River and the issues and concerns that may have an impact on water quality and quantity within the watershed. Twelve areas were identified: recreation, water supply, wildlife habitat, water quantity/flow, education, waste assimilation, aesthetics/scenery, agriculture, economic returns, historic resources/attributes, cultural resources and hydropower. The uses and values identified were critical in shaping the Watershed Study.

In Phase II the local watershed constituency continued to play an important role in the process of planning to maintain the ability of the Souhegan River and its watershed to support multiple uses. The information from Phase I was distributed to the advisory committee and a series of meetings were held to analyze the information and recommend future actions to implement the Study. The advisory committee was composed of individuals representing a broad spectrum of interests such as business, recreation, hydropower, fisheries and wildlife, and local government.

The Watershed Study examined the following areas: geology, soils, agriculture, wildlife, fisheries, vegetation, water resources, water quality, water quantity, hydropower, land use, zoning, road systems and recreation. The individual data layers were spatially displayed on maps using a geographic information system (GIS) which facilitated the calculation of area and the comparison or overlaying of the data layers. Where feasible, small versions of the GIS maps have been included in the Study to be used for general information purposes only. Where maps have not been included, it is due to a problem of scale; the information is rendered useless at the reduced scale. Each of the Watershed communities will be provided with a large scale set of the maps at the completion of the Study.

WATERSHED OVERVIEW

The Souhegan River is formed by the confluence of the South Branch and the West Branch Souhegan Rivers in New Ipswich. From there it flows 34 miles in a northeasterly direction through the towns of Greenville, Wilton, Milford, Amherst and Merrimack where it converges with the Merrimack River. The 171 square mile watershed includes portions of New Ipswich, Temple, Greenfield, Lyndeborough, Wilton, Greenville, Mason, Mont Vernon, Milford, Brookline, Amherst and Merrimack in New Hampshire and Ashby and Ashburnham in Massachusetts. Table I-1 includes information on the area of each community contained in the watershed.

Based on the 1990 Census, approximately 35,000 people live within the Souhegan River watershed. The three largest population centers, Milford, Amherst and Merrimack, comprise 66 percent of the total watershed population but represent only 27 percent of the total area. The remaining 34 percent of the population is spread throughout the remaining 79,760 acres of the watershed. The overall density of the watershed is 0.32 persons per acre. Correspondingly, there are 12,955 housing units with an average of 2.77 persons per unit.

TABLE I-1

SOUHEGAN RIVER WATERSHED

DEMOGRAPHICS

Community	*1990 Population in Watershed*	*1990 Housing Units*	*Persons Per Unit*	*Population Density in Watershed (persons/acre)*	*Acres in Watershed*	*% of Town in Watershed*
Amherst	6,236	2,151	2.90	0.53	11,762	53.3%
Ashburnham, MA	133	56	2.38	0.05	2,610	2.5%
Ashby, MA	119	42	2.83	0.04	2,748	4.4%
Brookline	100	33	3.03	0.40	249	1.9%
Greenfield	196	81	2.42	0.04	4,604	26.6%
Greenville	1,162	495	2.35	0.56	2,084	45.9%
Lyndeborough	1,151	429	2.68	0.08	15,164	77.4%
Mason	19	6	3.17	0.08	229	1.5%
Merrimack	5,577	1,806	3.09	1.10	5,067	24.0%
Milford	11,253	4,591	2.45	0.87	12,941	78.1%
Mont Vernon	1,525	516	2.96	0.18	8,339	77.6%
New Ipswich	3,520	1,162	3.03	0.24	14,566	68.6%
Temple	1,136	405	2.80	0.08	13,447	88.7%
Wilton	2,920	1,183	2.47	0.19	15,452	94.1%
TOTALS:	*35,047*	*12,955*	*2.71*	*0.32*	*109,262*	*N/A*

Source: Population and Housing Units based on 1990 US Census Block data.
Acres in Community and in Watershed computed based on GIS data by NRPC, 1993.
Ashby & Ashburnham population, housing and density data are estimated based on townwide averages.
Ashby & Ashburnham community sizes based on 1990 US Census data.
Watershed boundary as defined by NH Department of Environmental Services, 1990.

In general, the Souhegan River watershed is relatively undeveloped with 60 percent of the land falling into the vacant category. The developed area is broken down as follows: approximately 20 percent residential, 0.6 percent commercial, 0.8 percent industrial, 0.8 percent institutional and 8 percent open space/recreation. Active agricultural lands represent about 10 percent of the total watershed area. Approximately 9 percent of the watershed is classified as wetland soils while 29 percent is steeply sloped (15 percent slope or greater).

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SECTION II:

NATURAL RESOURCES

SECTION II: NATURAL RESOURCES

The initial step in the Souhegan River Watershed Study involves the examination of the physical and natural characteristics of the watershed. Existing and future land uses and activities within the watershed are constrained by physical characteristics. Steep slopes, depth to bedrock, soil capabilities for septic systems, wetlands, floodplains and significant groundwater deposits, individually or in combination, represent the major physical characteristics constraining, if not prohibiting, land development in the watershed. In addition, maintaining a diversity of plant and animal species, and the continued presence of threatened, rare or endangered species, depends on conserving a variety of habitats. Once destroyed, it is difficult if not impossible to recreate the specific habitat conditions for many species. In many instances, however, the negative impacts of development can be avoided through proper planning for the long-term conservation of the resource and through careful consideration of the physical and natural characteristics of the site prior to development.

GEOLOGY

The bedrock geology of the Souhegan River valley formed millions of years ago during the Ordovician, Silurian and Devonian periods. The original sedimentary rocks, deposited by shallow seas that once inundated much of New Hampshire, were faulted, folded, exposed to high temperatures and pressures, and eroded. These processes transformed the sedimentary rock into the metamorphic rock that exists today. Molten magma from the earth's core intruded into the overlying metamorphic rocks forming igneous intrusions of which granite is the most common in New Hampshire.

According to the "*Geologic Map of New Hampshire*", 1955, there are three major formations underlying the Souhegan valley. The Merrimack Group, located at the mouth of the Souhegan River, is comprised mostly of purplish-brown biotite schists, gray quartz-mica schist, greenish-gray actinolite-granulite and brown biotite-actinolite schist with garnet present throughout. West of this, the middle formation, encompassing most of Amherst, Milford and western Merrimack, contains mostly pink to gray, medium to coarse grained, massive to foliated biotite granite, quartz monzonite and granodiorite. The remaining portion of the watershed is underlain by the Littleton formation composed of gray micaceous quartzite and gray coarse grained mica schist, with such minerals as biotite, garnet, sillimanite, and locally, andalusite.

In addition, the 1977 "*Interim Geologic Map of New Hampshire*", indicates the presence of three young, high-angle faults in the watershed, the Spofford fault, the Pinnacle fault and the Campbell Hill fault. The Spofford fault runs northeast from the Rindge area through Wilton to South Lyndeborough. The Pinnacle fault runs northeast from New Ipswich through Wilton and South Lyndeborough and continues on up to Pittsfield. The Campbell Hill fault runs northeast from Mason through Milford and Mont Vernon and continues on its course to Rochester, NH. These faults are not known to be active.

About 100,000 years ago, glaciers invaded and covered most of New Hampshire. This period of glaciation is the most significant factor in the development of the existing landscape. The enormous force of the ice as it invaded and receded, scraped and molded the earth's surface creating the high peaks and outwash plains that exist in New Hampshire today. In addition, meltwater channels blocked by debris formed great shallow lakes. Information from the "*Surficial Geologic Map of the Milford Quadrangle*," USGS, 1970, indicates that glacial Lake Merrimack, which began just south of the New Hampshire-Massachusetts line, extended up the Souhegan River to Milford center. Other deposits in the area contain sands and gravels which were lain down by meltwater streams controlled by bedrock spillways. Stream terrace deposits along the Souhegan River cut into former glacial lake or glacial stream deposits during late glacial time. Substantial alluvium deposits, light

gray to white fine sands and silts, underlie the existing floodplains of the Souhegan River while much of the watershed is covered by glacial till.

Streams flowing from the melting glaciers deposited sediments in layers of similar sized grains. Because of their ability to store and transmit high volumes of water, these stratified drift deposits are often excellent sources of groundwater. The relationship between glacial stratified drift deposits and aquifers is documented in a study conducted by the United States Geological Service in 1987, entitled Hydrogeology of Stratified-Drift Aquifers and Water Quality in the Nashua Regional Planning Commission Area, South Central New Hampshire. This study indicates that the Souhegan River, except for a section in southwest Wilton, is underlain by stratified drift deposits of varying thicknesses and textures. The USGS 1977 map "Availability of Ground Water in the Lower Merrimack River Basin, Southern New Hampshire", the predecessor of the 1987 study, indicates limited stratified drift deposits with high water yielding potential in the Souhegan River corridor west of Wilton along the Souhegan River and its tributaries. The towns of Merrimack, Milford and Wilton rely on these deposits for present and future municipal water supplies. Information from the Upper Naukeag Lake Water Supply Watershed Resources Protection Plan, Montachusett Regional Planning Commission, indicates an aquifer with the potential to yield 100-300 gallons per minute around Ward Pond in Ashburnham. A more detailed discussion of these aquifers and existing aquifer protection in the study area can be found in the section on groundwater in Chapter III.

Sand and Gravel Deposits

The characteristics that make stratified drift deposits good sources of water also make them excellent sources of sand and gravel. Map III-1, Souhegan River Watershed Groundwater Resources, indicates the extent of stratified sand and gravel deposits in the watershed. In addition, the map "*Surficial Geology of New Hampshire*", 1950, indicates the locations of stratified gravel and sandy gravel deposits in kame terraces and eskers. While the majority of these deposits are located in areas identified as stratified drift aquifers in the 1987 USGS study, smaller deposits are scattered throughout the watershed in Amherst, Mont Vernon, Lyndeborough, Greenfield, Wilton, Temple and New Ipswich. These sorted deposits of sand and gravel provide a ready supply of an important and necessary construction material. Improper removal and storage of these materials and poor site reclamation, however, can have a significant impact on surface water and groundwater quality. Since soil serves as a natural filter and removes suspended contaminants, the removal of too much soil can reduce the filtering capacity and increase the potential for contaminants to reach groundwater. Surface waters can be impaired by increased turbidity and sedimentation caused by erosion at excavation sites.

NH RSA 155-E, Local Regulation of Excavations, gives communities the authority to regulate excavations by adopting excavation regulations. Properly designed, implemented and enforced excavation regulation can protect sensitive surface water and groundwater resources from potential negative impacts. As always, local regulations can be more stringent than the provisions in the statute. The statute, however, specifically prohibits excavations "that would substantially damage a known aquifer, so designated by the United States Geological Survey" and excavations within 75 feet of a navigable river. In addition, the statute requires excavation sites be reclaimed and that a bond or other security to cover the cost of reclamation be placed with the regulator prior to any excavation of the site.

SOILS

The soils found in a region are directly related to the geologic history of the area. The soils in the Souhegan River watershed formed in glacial deposits overlying bedrock. The majority of the upland areas in the watershed are covered by glacial till 20-30 feet thick, while sand and gravel were deposited in terraces along glacial streams or on outwash plains at the bottom of the valleys. Aside from the minimal soil deposition on

floodplains and the build up of organic deposits in wetlands, little change has taken place in the landscape of the watershed since the last glacier melted about 12,000 years age.

The Soil Conservation Service (SCS) has conducted extensive surveys and analyses of the soils of Hillsborough County, NH and Middlesex County, MA. Information on the soils in the Souhegan River watershed can be found in the Soil Survey for Hillsborough County, Eastern Part and the Soil Survey for Hillsborough County, Western Part, published in 1981 and 1985 respectively, and the Middlesex County Massachusetts Interim Soil Survey Report, published in 1986. The soil survey for Worcester County, MA is not yet published. The surveys delineate soil types and provide general information on each soil's characteristics. Each soil type is evaluated and rated with regard to development potential for specific land uses such as crops and pasture, forestry, recreation, wildlife habitat, building site development and sanitary facilities.

The soil surveys are mapped at a scale of 1:20,000. At this scale, the smallest soil units mapped are approximately 3 acres. Each map unit represents an area that consists of one or more soils. The name and symbol for the map unit is based on the dominant soil type. Most map units include small scattered areas of other soil types with properties that may differ substantially from the dominant soil. Because of these limitations, the information provided in the Soil Surveys is most useful for general planning purposes like this study. On-site soil evaluations should be conducted to ascertain the suitability of a site for a specific use.

The general information provided in the Soil Surveys can be used to evaluate constraints and potentials for development on a broad scale. The information is used in this study to assess topography and slope, wetlands, floodplains and the potential for subsurface waste disposal.

Topography and Slope

Topography is the general form of the land surface. As previously discussed, New Hampshire's topography is largely due to the glaciers that covered the state until about 14,000 years ago. Since that time, numerous factors, such as wind, water, temperature, floods, earthquakes and man, have subtly and sometimes dramatically altered the landscape.

Elevation and slope are the two major components of topography. Elevation is the measure of the height of a given point of the land surface relative to mean sea level. Slope is a measure of the pitch or the steepness of the surface between two given points and is calculated by dividing the change in elevation, rise, by the distance, run, between the two points (rise/run). The slope of the land is a critical determinant of its ability to support certain land uses.

Overall, the topography of the watershed varies widely from flat, floodplains in the eastern portion to rolling hills and steep slopes in the west. Watershed elevations range from a high of 2,280 feet at the summit of Pack Monadnock Mountain in Peterborough and 2,276 feet at the summit of North Pack Monadnock in Greenfield to roughly 50 feet at the confluence of the Souhegan and Merrimack Rivers in Merrimack. In its 34 miles, the River drops approximately 900 feet from New Ipswich, 950 feet above Mean Sea Level (AMSL), to the Merrimack River, 50 feet AMSL, an average drop of 28 feet per mile. This average is misleading since there are places where the River drops off more quickly forming rapids in Greenville, Wilton and Merrimack. Of note is Wildcat Falls in Merrimack where the River drops 83 feet over a series of three falls.

Slope is one of the limiting factors to be considered when determining the development potential of a parcel of land. Information on slope is generally considered in conjunction with the other environmental factors of geology, soils and hydrology. Generally speaking, slopes of 0 to 3 percent are not well drained and are often associated with wetlands. Land with slopes of 3 to 8 percent and good soil is usually considered ideal for

development because constraints are minimal, while development on slopes of 8 to 15 percent will require some additional planning to provide for proper drainage and soil stabilization. Areas of moderate slope, 15 to 25 percent, are sensitive to development and best suited for open space uses such as natural areas, hiking and nature trails, picnic areas, environmental education and outdoor recreation. With proper design, however, and providing other environmental conditions are favorable, these areas can successfully be developed for more intense uses. Slopes greater than 25 percent are very steep and highly susceptible to erosion if developed.

Since the USGS topographic information is not available on GIS for New Hampshire, slope information for the watershed is derived from the USDA Soil Survey for Hillsborough County, Eastern Part, the Soil Survey for Hillsborough County, Western Part and the Middlesex County Massachusetts Interim Soil Survey Report. In the soil survey, each map unit is identified by soil type, categorized by slope and given a symbol, e.g. Monadnock fine sandy loam, 8-15 percent slopes - 142C and Canton stony fine sandy loam, 3-8 percent slope -- CmB. The last letter of the symbol generally identifies the slope category of the soil as follows: A 0-3 percent slope, B 3-8 percent slope, C 8-15 percent slope, D 15-25 percent slope and E 25-35 percent slope. Category D and E slopes are identified on the Steep Slopes Map since they present the greatest constraints to development. Given the limitations inherent in the soil surveys, discussed in the *SOILS* section, the information provided by this analysis is adequate for general planning purposes and site specific evaluations should be made for individual proposals.

The Steep Slopes Map, Map II-1, displays the slopes with the most significant development limitations and the greatest potential to cause environmental damage if developed, the D and E categories. The map indicates that the most extensive areas of steep slopes are located in the western reaches of the watershed in Greenfield, Lyndeborough, Temple, Wilton and New Ipswich. This is to be expected since the western boundary of the watershed follows the Wapack Range. Slope information for the entire watershed is detailed in Table II-1. Overall, 28.4 percent of the land within the watershed is categorized as having steep slopes, while one-third or greater of the watershed areas in Greenfield, Greenville, Temple, New Ipswich, Lyndeborough and Wilton are included in this category.

Areas with slopes greater than 25 percent are highly sensitive to disturbance and should be protected to reduce the potential for erosion and the resulting sedimentation and associated water quality problems in surface waters and wetlands. The impact of soil erosion and sedimentation is discussed in more detail in the section on Nonpoint Sources of Pollution in Chapter III. To highlight the major points, erosion and the resulting sedimentation can increase the turbidity of the water, decrease available levels of oxygen, destroy important fishery habitats, decrease the capacity and lifespan of impoundments and modify the flow of the water such that streambank erosion is accelerated.

Steep slopes also present a number of problems when considering the development of recreation areas. Canoe launches located on steep banks, for example, would require major alterations of the site. Trails in steep slope areas would also have to be carefully designed and constructed. While foot traffic on steep slopes could negatively affect vegetative cover leaving open areas where runoff would concentrate and increase erosion along the path and lower areas on the slope. In addition, steep slopes present a number of safety concerns, particularly for children, older adults and the physically challenged.

Wetlands

Once thought of as wastelands and areas to be filled, awareness of the important role wetlands play in the hydrologic and ecologic systems has increased significantly over the last decade. Wetlands perform many important functions such as flood control and natural stream flow regulation, erosion and sedimentation control, and water purification while providing nursery grounds and habitat for numerous species of vegetation and wildlife.

Wetlands are defined in a number of different manners by different agencies; however, the wetland definitions of the four federal agencies, the Army Corps of Engineers (CE), the Soil Conservation Service (SCS), the Environmental Protection Agency (EPA) and the Fish and Wildlife Service (FWS), are conceptually the same and include three basic elements -- hydrology, vegetation and soils -- for identifying wetlands. An attempt to develop a single, consistent approach for delineating wetlands that would satisfy the requirements of the four agencies resulted in the Federal Manual for Identifying and Delineating Jurisdictional Wetlands, January, 1989. Despite the support of the four agencies, the Federal Manual met with great political opposition and wetland identification and delineation remains a tangled web.

TABLE II-1

SOUHEGAN RIVER WATERSHED

SLOPES

	SLOPE						
	A	*B*	*C*	*D*	*E*	*Total*	*% Steep*
Community	*0-3%*	*3-8%*	*8-15%*	*15-25%*	*25+%*	*Acres*	*(D&E)*
Amherst	3,496	2,491	4,294	1,446	35	11,762	12.6%
Ashburnham, MA	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ashby, MA	312	816	1,009	545	66	2,748	22.2%
Brookline	21	25	85	118	0	249	47.4%
Greenfield	503	1,015	1,268	1,818	0	4,604	39.5%
Greenville	92	657	618	717	0	2,084	34.4%
Lyndeborough	918	3,003	5,298	5,945	0	15,164	39.2%
Mason	0	166	27	36	0	229	15.7%
Merrimack	1,463	1,470	1,406	717	11	5,067	14.4%
Milford	2,405	2,991	4,926	2,448	171	12,941	20.2%
Mont Vernon	775	1,657	4,514	1,213	180	8,339	16.7%
New Ipswich	1,668	3,238	4,953	4,611	96	14,566	32.3%
Temple	1,212	2,851	3,878	5,489	17	13,447	40.9%
Wilton	1,544	3,563	5,060	5,039	246	15,452	34.2%
TOTALS	*14,409*	*23,942*	*37,336*	*30,142*	*822*	*106,652*	*29.0%*

Source: Based on GIS computations by the NRPC, 1995.
Soils as described in Soil Survey of Hillsborough County, NH Eastern Part, 1981 and
Soil Survey of Hillsborough County, NH Western Part, 1985, and
Soil Survey of Middlesex County, MA, 1986.

Additional information from Soil Potentials for Development, Hillsborough County, 1986.
Watershed boundary as defined by NH DES, 1990.
Asburnham information is not available.

The Administrative Rules of the New Hampshire Wetlands Board define freshwater wetlands as follows:

> "those areas that are inundated or saturated by surface or ground water at a frequency and duration to support, and that under normal conditions do support a prevalence of vegetation typically adapted for life in saturated soil conditions." (Section 101.01)

The Wetlands Board Rules also establish the 1989 Federal Manual as the standard by which wetlands are to be identified and delineated.

Wetland definitions and district boundary determinations are contained in the Zoning Ordinances of eight communities in the watershed. Merrimack, Amherst, Milford, Lyndeborough, Mont Vernon, Wilton and Greenfield and New Ipswich rely on poorly and very poorly drained soils as designated by the SCS soil surveys for Hillsborough County and/or other areas that through field identification meet the requirements for poorly or very poorly drained soils but are not so designated. Milford's definition also includes areas that support hydrophytic vegetation. The Greenville and Temple Zoning Ordinances do not contain any definitions for wetlands or include wetland conservation districts.

Wetlands in Ashby and Ashburnham are protected by the Massachusetts Wetlands Protection Act, MGL Chapter 131, section 40. Relative to the Souhegan watershed communities, the Act regulates any activity that would remove, fill, dredge or otherwise alter any inland wetland which includes bordering vegetated wetlands, land subject to flooding, land under water bodies and waterways, and banks. The regulations which implement the Act, Section 310 Code of Massachusetts Regulations (CMR) 10.00: Wetland Protection, define each inland wetland category separately. The provisions of the Act are administered at the local level by the Conservation Commission and are discussed in more detail in the following paragraphs.

Since seven communities within the watershed define wetlands based on poorly and very poorly drained soils and the Hillsborough County soil surveys are available as a Geographical Information System (GIS) data layer, poorly and very poorly drained soils are used to evaluate the location and extent of wetlands within the watershed. The GIS soil information was used to develop a wetland map for the watershed, Map II-2. In addition, the FWS's National Wetlands Inventory (NWI) maps were used to supplement the evaluation of wetlands in the watershed. The NWI maps were developed from aerial photographs and wetlands were identified based on vegetation, visible hydrology and geography in accordance with the classification system established in the publication Classification of Wetlands and Deepwater Habitats, US Dept. of the Interior, Fish and Wildlife Service, 1979. Both systems are accepted standards for preliminary evaluations of wetlands and are often used in conjunction with one another; however, the NWI information is not available as a GIS data layer.

As indicated on the Wetland Soils Map, Map II-2, wetlands within the Souhegan River watershed are not extensive and are confined to low-lying areas adjacent to the River and its tributaries and depressions located throughout the watershed. The location and extent of the wetland soils within the watershed is directly related to glacial activity within the region. As discussed, the topography in the western sections of the watershed is relatively steep; steep slopes with shallow soils do not promote the development of wetlands. In addition, glacial till is present throughout much of the watershed and substantial deposits of stratified drift are located in the central and eastern portions of the river corridor; these porous sand and gravel deposits readily transmit water and therefore are not prime locations for wetland formation.

Overall, wetland soils represent about 8.9 percent, 9,709 acres, of the total watershed area. While only four of the watershed communities contain greater than ten percent wetlands in their portion of the watershed, wetland areas in Amherst, Lyndeborough, Milford and New Ipswich exceed 1,000 acres. Table II-2 summarizes soil drainage classifications within the watershed; poorly and very poorly drained soils have been classified as wetlands for this analysis.

TABLE II-2
SOUHEGAN RIVER WATERSHED
SOIL DRAINAGE CLASSIFICATIONS AND WETLAND SOILS

Community	Excessively Well Drained	Well Drained	Moderately Well Drained	Poorly Drained	Very Poorly Drained	Not Deter-mined	Total Wetland Acres	Total Wetland Percent
Amherst	3,402	5,260	1,413	660	1,027	0	1,687	14.3%
Ashburnham, MA	N/A	N/A	N/A	N/A	N/A	139	139	5.3%
Ashby, MA	372	1,578	347	180	271	0	451	16.4%
Brookline	0	131	95	15	8	0	23	9.2%
Greenfield	497	3,482	240	142	243	0	385	8.4%
Greenville	22	1,811	125	106	20	0	126	6.0%
Lyndeborough	540	12,872	746	631	375	0	,006	6.6%
Mason	0	220	0	9	0	0	9	3.9%
Merrimack	1,873	1,900	734	390	170	0	560	11.1%
Milford	3,384	6,089	2,117	801	550	0	,351	10.4%
Mont Vernon	21	6,105	1454	372	387	0	759	9.1%
New Ipswich	1,208	11,010	995	973	380	0	,353	9.3%
Temple	632	10,820	1,074	663	258	0	921	6.8%
Wilton	2,680	10,932	901	583	356	0	939	6.1%
TOTAL	*14,631*	*72,210*	*10,241*	*5,525*	*4,045*	*139*	*9,709*	*8.9%*

Source: Based on GIS computations by the NRPC, 1995, rounded to the nearest acre.

Soils as described in Soil Survey of Hillsborough County, NH Eastern Part, 1981, and Soil Survey of Hillsborough County, NH Western Part, 1985, and Soil Survey of Middlesex County, MA, 1986 Additional information from Soil Potentials for Development, Hillsborough County, 1986. Watershed boundary as defined by NH DES, 1990. Ashburnham soils from the Upper Naukeag Lake Water Supply Watershed Resources Protection Plan by the Montachusett Planning Commission, April, 1993.

Wetlands deserve to be protected from degradation for a number of reasons. First, wetland areas provide suitable habitats for a diversity of wildlife species. Second, wetlands provide natural flood control. Third, wetlands are visually aesthetic and provide diversity in the landscape. And finally, wetlands provide a certain level of water purification by filtering sediments, nutrients and chemicals from surface water runoff. It is therefore, very important that the integrity of wetlands be preserved to maintain ecologic and hydrologic balance.

The ordinances of the twelve watershed communities provide a wide range of protection for wetlands. The Greenville and Temple zoning ordinances contain no formal protection mechanisms for wetlands. The New Ipswich, Greenfield, Wilton, Lyndeborough, Mont Vernon, Milford, Amherst and Merrimack wetland conservation districts generally permit any use which does not result in the erection of any structure or alter the surface configuration of the wetland by the addition of fill or by dredging and that is otherwise permitted by the Zoning Ordinance. Greenfield prohibits the location or enlargement of septic tanks or leachfields within 125 feet of a wetland while Wilton's setback ranges from 75-125 feet based on the permeability of the receiving soil. The Milford district establishes a 25 foot buffer from the edge of the wetland in which no construction or ground disturbance shall occur. The typical uses such as conservation areas, parks and recreation uses, forestry and agriculture and small buildings which do not require a building permit are

permitted in the buffer. The following uses are specifically prohibited within the buffer: septic tanks and leachfields, buildings or structures which would require a building permit, in-ground or above ground swimming pools, decks requiring inground foundations and stockpiling of manure. The Amherst district prohibits the erection of any structure within 50 feet of any wetland. In addition, the Wilton, Milford and Merrimack districts permit certain uses by special exception which may include the erection of a structure, dredging, filling, draining or otherwise altering the surface configuration of the land, if it can be shown that the proposed use will not conflict with the purpose and intent of the district and if the proposed use is otherwise permitted by the zoning ordinance.

The two Massachusetts communities, Ashby and Ashburnham, regulate wetlands under the Massachusetts Wetlands Protection Act. With respect to the watershed, this includes the inland wetland categories of bordering vegetated wetlands, land subject to flooding, land under water bodies and waterways, and banks. In addition, any activity within a 100 foot buffer zone of any defined wetland, except land subject to flooding, that would alter or impact a wetland resource is also subject to regulation under the Act. The regulations for implementing the Act are contained in Section 310 Code of Massachusetts Regulations (CMR) 10.00: Wetland Protection. The regulations establish the process for reviewing projects with a potential impact on wetlands, define each of the four inland wetland categories, provide performance standards for activities adjacent to or within wetlands and establish variance procedures. The Conservation Commission (CC) is the local body charged with implementing the provisions of the Act and the regulations. A permit called an Order of Conditions must be obtained from the CC prior to conducting any work within a wetland or within the buffer zone. Upon receipt of an application/Notice of Intent to perform work, the CC will review the proposed project to determine its impact on the wetland resource and its compliance with the performance standards. Following its review of the project and a public hearing, the CC will issue an Order of Conditions, either approving, approving with conditions or denying the project. Work will be permitted on the site only after an Order of Conditions approving the project has been issued by the CC. The Act requires a fifty foot setback from the edge of the wetland for all leach fields and additional requirements for specific wetland categories.

Floodplains

Floodplains are areas adjacent to water courses and water bodies that are susceptible to flooding during periods of high surface water runoff. The floodplains of the Souhegan River and its major tributaries are depicted on Map II-3, Alluvial Soils. Alluvial or floodplain soils have been identified by the SCS as part of the Soil Survey for Hillsborough County, Eastern and Western Parts and the Middlesex County Massachusetts Interim Soil Survey Report. The information on alluvial soils can be used by communities to plan for appropriate uses of the floodplains to prevent the loss of life and property. While the most significant flooding in the Souhegan River watershed occurred in 1936, 1938 and 1955, lesser flooding happens on a more regular basis throughout the watershed, as recently as 1993 and 1994 in some areas.

The Alluvial Soils Map shows that the majority of the floodplains are located along the Souhegan River in Milford, Amherst and Merrimack. Of the 2,699 acres of alluvial soils in the watershed 1,862 or 70 percent are within these three Towns. Alluvial soils represent only 2.5 percent of the total watershed area. Wilton and New Ipswich also have notable floodplain areas predominantly located along the tributaries to the Souhegan River.

Severe damage caused by the floods in 1936, 1938 and 1955, led to a cooperative effort begun in 1957 between the communities, the state of NH, the SCS and the Hillsborough and Middlesex County Conservation Districts to reduce the impact of flooding. The Souhegan River Watershed Project recommended the construction of thirteen flood control structures, strategically placed throughout the watershed, designed to retain water during periods of high runoff and release the stored water at a slower rate over an extended period of time. The study estimated reductions in annual flood losses of 75 percent and in major flood losses of 66

percent. By 1969, nine of the thirteen structures were built and at present all but one of the structures has been completed. The flood control system is managed by the New Hampshire Department of Environmental Services.

In 1968 Congress created the National Flood Insurance Program to reduce the losses from flooding. As part of the program, the Federal Emergency Management Administration (FEMA) and the Federal Insurance Administration (FIA) conducted studies and prepared a series of maps which identify the floodway, the 100 year floodplain and the 500 year floodplain. Studies have been conducted and maps are available for all of the New Hampshire communities except Temple and for both Massachusetts communities. Because the FEMA floodplain maps were created for a specific purpose, determining eligibility for flood insurance, the maps are limited in their use for general planning purposes. More specifically, the FEMA maps are based on topography and not a formal coordinate system, i.e. latitude and longitude; thus, the maps cannot be reconciled with other established base maps.

Aside from transmitting floodwaters, floodplains provide areas for groundwater recharge, wildlife habitat, open space and recreation. These low intensity uses are highly compatible with the goal of alleviating the economic and human losses associated with flooding. Picnic areas, recreational facilities, parking areas, hiking, biking and skiing trails are just a few examples of low intensity uses for floodplains.

Soil Septic System Capability

The capability of the soil to support subsurface waste disposal is an important characteristic to consider when assessing development in the Souhegan River watershed since the majority of the watershed residents and businesses rely on septic systems for waste disposal. Only four communities in the watershed are served in-part by public sewer systems, Merrimack, Milford, Wilton and Greenville, and service is generally limited to the urbanized areas of these communities.

To assist communities in planning for future development based on soil capabilities, the Hillsborough County Conservation District devised a rating system to indicate the relative potential of a soil for development, Soil Potentials for Development, Hillsborough County, NH, March, 1986. Soils were evaluated in four categories, septic tank absorption fields, local roads and streets, dwellings with basements and overall development. Five rating classes, very high, high, medium, low and very low, were established based on a numerical comparison of the soil with a theoretical reference soil. The characteristics of the reference soil for the septic system absorption field include: the area is located on a gently sloping area of five percent slope; the depth to the high water table and bedrock is greater than ten feet; the area is not subject to flooding; there are less than three percent surface stones; and the soil has a percolation rate of twelve to fifteen minutes per inch.

In Massachusetts, the USDA SCS and the Conservation Districts conducted a similar study for Middlesex and Essex Counties, Soil Potential Ratings for Septic Absorption Fields, March 1985. This evaluation utilizes the same five rating classes and very similar characteristics for the reference soil: perc rate of 10 minutes per inch, slope of five percent or less, depth to water table greater than six feet, depth to bedrock greater than six feet, non-stony and no hazard of flooding.

The soils identified in both studies with low and very low potential ratings for septic systems are depicted on Map II-4, Soil Septic System Capability. Areas with low potential ratings have site conditions and soil properties significantly below the reference soil and the cost for overcoming these limitations is very high. Areas with very low potential ratings have severe soil limitations and the cost for overcoming these limitations is extremely high or prohibitive. Soil limitations for these categories include: seasonal high water table, soil wetness, permeability, depth to bedrock and slope. It should be reiterated that the smallest soil unit mapped by the Soil Survey is approximately three acres in size and that smaller areas of soils with properties suitable for

subsurface waste disposal may be included within the areas indicated on the map with low or very low ratings. As stated previously, the information is presented for general planning purposes and soil evaluations should be conducted for development proposals on a site specific basis.

An examination of the map indicates that the soils with limited capabilities for septic systems in the watershed are predominantly located in the western communities. This is related in part to the steeper slopes and shallower soils in the western region. Table II-3 provides information on soil septic system capabilities for the watershed broken out by community. Soils with low or very low septic system ratings in Amherst, Merrimack and Mont Vernon comprise less than 30 percent of the watershed area in these communities, as compared to the western region where over 55 percent of the watershed areas in the communities are in these two categories. Overall, 49.2 percent of the watershed, approximately 52,526 acres, is limited by soils with low or very low septic system capabilities.

TABLE II-3

SOUHEGAN RIVER WATERSHED

SOIL SEPTIC SYSTEM CAPABILITIES

Community	*Very High*	*High*	*Medium*	*Low*	*Very Low*	*Watershed Total*	*% Low/ Very Low*
Amherst	3,199	1,700	3,242	391	3,230	11,762	30.8%
Asburnham, MA	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ashby, MA	165	391	374	178	1,640	2,748	66.2%
Brookline	80	36	6	22	105	249	51.0%
Greenfield	1,068	0	785	231	2,520	4,604	59.8%
Greenville	20	12	768	171	1,113	2,084	61.6%
Lyndeborough	3,856	12	1,860	951	8,485	15,164	62.2%
Mason	14	0	29	0	186	229	81.2%
Merrimack	1,068	557	1,729	320	1,393	5,067	33.8%
Milford	3,359	1,417	3,545	794	3,826	12,941	35.7%
Mont Vernon	3,659	682	1,747	935	1,316	8,339	27.0%
New Ipswich	2,304	189	4,228	1,462	6,383	14,566	53.9%
Temple	2,553	25	2,501	1,095	7,273	13,447	62.2%
Wilton	3,173	183	3,590	970	7,536	15,452	55.0%
TOTALS:	*24,518*	*5,204*	*24,404*	*7,520*	*45,006*	*106,652*	*49.2%*

Source: Based on GIS computations by the NRPC, 1995.

Soils as described in Soil Survey of Hillsborough County, NH Eastern Part, 1981, and Soil Survey of Hillsborough County, NH Western Part, 1985, and Soil Survey of Middlesex County, MA, 1986. Additional information from Soil Potentials for Development, Hillsborough County, 1986, and Soil Potential Ratings for Septic Absorption Fields, Middlesex and Essex Counties, 1985. Watershed boundary as defined by NH DES, 1990.

AGRICULTURE

The US Department of Agriculture has identified soil types that are best suited to crop production based on soil quality, growing season and moisture supply. These prime farmland soils are likely to produce the highest crop yields, require the least amount of economic inputs and cause the least environmental damage. While prime farmland is an important resource, the retention of active agricultural lands is perhaps a greater concern

at this time since it is unlikely that additional land will be converted to agricultural use in the near future. Land in active agricultural production is an important community resource.

Active agricultural operations within the NH portion of the watershed were assessed using 1991 aerial slides provided by the Agricultural Stabilization and Conservation Service (ASCS). Agricultural lands were identified on the slides and information on location, size and type of use was transferred onto community tax maps. The information from the tax maps was then digitized to create a GIS agricultural data layer. Information for Ashby and Ashburnham was obtained from the Watershed Resource Protection Plan, Nashua River Basin, Upper Naukeag Lake Water Supply Study, February 1993, prepared by the Montachusett Regional Planning Commission. The information obtained from both sources is presented on Map II-5, Souhegan River Watershed Agriculture, in three major categories: tilled land, untilled land and orchard. Table II-5 contains a breakdown of the active agricultural categories by community.

TABLE II-4

SOUHEGAN RIVER WATERSHED

ACTIVE AGRICULTURAL LAND

Community	*Tilled*	*Untilled*	*Orchard*	*Not Defined*	*TOTAL*
Amherst	395	922	33	0	1,350
Ashburnham, MA	0	0	0	106	106
Ashby, MA	0	0	0	149	149
Greenfield	0	178	0	0	178
Greenville	0	87	0	0	87
Lyndeborough	227	886	668	0	,781
Merrimack	0	163	0	0	163
Milford	3	1,192	0	0	,195
Mont Vernon	15	818	0	0	833
New Ipswich	38	985	0	0	,023
Temple	77	1,359	372	0	1,808
Wilton	274	948	470	0	1,692
TOTAL	*1,030*	*7,516*	*1,542*	*255*	*10,346*

All figures rounded to nearest acre.

Source: NH agriculture interpreted from 1992 air photos provided to the NRPC by the Hillsborough County Soil Conservation Service.

MA agriculture from the Upper Naukeag Lake Water Supply Watershed Resources Protection Plan by the Montachusett Regional Planning Commission, 1993.

The 10,346 acres of active agricultural land represents approximately ten percent of the entire watershed. In 1969, the Hillsborough County Conservation District estimated active agricultural land at 17,600 acres or sixteen percent of the watershed. Agricultural land is somewhat evenly distributed in the watershed with seven of the twelve towns having over a thousand acres. Untilled agriculture, hay and pasture, at 7,469 acres represents 73 percent of the agricultural land in the watershed and the greatest use in each community except for Lyndeborough. Orchards are significant in Lyndeborough, Wilton and Temple, 886, 477 and 446 acres respectively, and comprise eighteen percent of the agricultural land in the watershed. Tilled agricultural land is the smallest category, nine percent of the watershed, and is limited mostly to corn, produce and berry

operations. There are three dairy farms in the watershed, two in Wilton and one in Milford, and two large horse stables, one in Wilton and one in Temple.

Besides their importance for the production of food and fiber, agricultural lands are important to a community for other purposes. The open fields and farm buildings provide important open space and diversity in the landscape; supply diverse habitats for resident wildlife and migratory species; and maintain the presence of farming culture. To preserve this important resource, it is essential that productive farmland be maintained in parcels large enough to provide for efficient use of the land and to generate sufficient economic returns for the farmer.

WILDLIFE

The Souhegan River watershed provides habitat for a diversity of wildlife species. This diversity provides many recreational opportunities for bird watching and hunting. A variety of habitats such as wetlands, forests, fields, rivers and streams are required to meet individual species needs and to maintain healthy breeding populations. Maintenance of quality habitat is key to the survival of all species.

Mammals represented in the watershed are those commonly found in southern New Hampshire. These include raccoons, skunks, muskrats, beavers, porcupines, white tail deer, woodchucks, squirrels, mice, bats, rabbits and other indigenous species adapted to living near humans. The more rural areas of the watershed may also provide habitat for larger animals that require extensive habitat areas, or species that require solitude such as moose, black bear and lynx.

The New Hampshire Fish and Game Department is conducting a study to identify and map deer wintering areas throughout the state. Softwood stands ten acres or larger in size are identified on aerial photographs and field checked to confirm the presence of deer. Use of these areas in any year depends on many factors including deer population density, food availability, winter severity and changes in adjacent land use. In addition, areas below the detection limits of this survey may also provide important winter habitat. Maintenance of these critical habitats is essential to the survival of the species. The information obtained in the study can be used by the Department to assist communities, conservation organizations and individuals in planning for the wise management of these important habitats. Within the watershed, information is available for Greenville, Milford, New Ipswich, Temple and Wilton.

The New Hampshire Natural Heritage Inventory (NHI), a program of the Department of Resources and Economic Development (DRED), is the agency responsible for cataloging and tracking endangered, threatened and rare animal species in the State. The agency uses a ranking system developed by the Nature Conservancy to assess the rarity of the species. The ranking system is composed of two components, a global rank, assigned by the Nature Conservancy, and a state rank assigned by the NHI. A copy of the ranking system is attached in Appendix A. The Heritage Inventory indicates the presence of seven threatened species in the watershed: the eastern hognose snake, Woodhouse's toad, the blue spotted salamander, Blanding's turtle, the spotted turtle, the marbled salamander and the great blue heron. The general locations where these and other species have been sighted are depicted on Map II-6, Threatened or Endangered Species.

Depending on the season, the watershed is host to a wide diversity of bird species. Similar to the animal species, the birds found in the corridor are those indigenous to southern New Hampshire. Species of gulls, doves, woodpeckers, chickadees and jays would be found throughout the year while other species such as warblers, sparrows, wrens, swallows, robins and several species of raptors are only seasonal residents. Other species including a variety of ducks, geese and herons nest in the area or migrate through the watershed. The Department of Fish and Game defines any wetland in the watershed as important habitat for migratory waterfowl.

FISHERIES

Native species of fish in the Souhegan River watershed include small mouth bass, sunfish, pumpkin seeds, yellow perch, suckers and dace. In addition, the River and its tributaries are annually stocked with trout by the New Hampshire Department of Fish and Game. During 1992, 1,120 rainbow trout, 2,350 brown trout and 2,800 brook trout were released into the Souhegan River and its tributaries. When released, the trout are of a legal size for angling, representing what is called a "put and take" program.

The Souhegan River is an important part of the Merrimack River anadromous fish restoration program and is considered by fisheries biologists to be one of the most productive rivers in the watershed. The upper reaches of the Souhegan provide the appropriate habitat - gravelly, sloping bottoms, water temperatures, oxygen levels and food sources - for excellent growth and survival of Atlantic salmon frye. An average of 100,000 Atlantic salmon frye are stocked in the Souhegan River annually. These salmon frye will remain in the river system for two years before making their way to the Atlantic ocean. The dams on the River are equipped with downstream fish passage measures only at this point since natural reproduction is not expected. The Merrimack River Basin Fish Passage Action Plan for Anadromous Fish, January 1988, calls for the construction of upstream passage at the Merrimack Village dam when a specific number of shad pass through the Amoskeag dam. All other upstream passage is deferred.

VEGETATION

As with wildlife and fish, the types of vegetation found in the Souhegan River watershed are generally those species indigenous to southern New Hampshire. Typical species include white pine, hemlock, red maple, red oak, sycamore, mountain laurel and numerous species of grasses and shrubs. Forest land is the dominant land use in the watershed outside of each community's Town center and the urbanized areas along the NH Route 101 corridor. Much of the forest land within the watershed is actively managed for timber harvesting, as well as for wildlife management. Proper management of forest lands can ensure continued availability of quality wood products, provide diverse wildlife habitats and stabilize the River bank. The use of mechanisms designed to minimize the impacts of tree harvesting, called best management practices, can be utilized to protect the River from negative impacts. The NH Department of Resources and Economic Development has developed a guide, Best Management Practices for Erosion Control on Timber Harvesting Operations in New Hampshire, which outlines best management practices.

The New Hampshire Natural Heritage Inventory (NHI) is the agency responsible for identifying and recording the State's rare, threatened or endangered plant species. Plants are ranked using the Nature Conservancy system in the same manner as wildlife. NHI records indicate the presence of 21 threatened or endangered plant species and seven exemplary natural communities within the watershed. The 21 plants are: Long's bitter cress, wild lupine, bird's foot violet, Siberian chives, skydrop aster, goat's rue, stiff tick-trefoil, giant rhododendron, wild sienna, Maryland tick-trefoil, northern blazing star, sweet goldenrod, fall witch-grass, blunt-leaved milkweed, Virginian Mt. mint, burgrass, butterfly-weed, slender bush-clover, wild senna, climbing fumitory and sweet coltsfoot. Natural communities are "assemblages of plants and animals ecologically related to each other and their physical environment." These seven areas represent intact examples of New Hampshire's native flora and fauna, and have been described by the NHI as having the following characteristics:

> Southern New England High-energy Riverbank Community - A broadly defined community occupying high-energy environments of riverbanks and shores. This community may be present as a narrow, continuous, zone of rocky shores or otherwise open riverbanks characterized by herbaceous and shrub vegetation and regularly scoured by floodwaters and ice.

Southern New England Floodplain Forest - Floodplain forests characterized by silver maple in NH occupy regularly flooded alluvial terraces along the margins of major rivers. This is a broadly defined community as considerable floristic variation exists between high and low floodplain resulting from differences in the periodicity, intensity and duration of flooding. Deposition and erosion in the river channel through time generates successive point bars, particularly on meanders. A ridge and swale topography results with bands of vegetation corresponding to the flood regime.

Southern New England Acidic Level Fen - Grass or shrub dominated peatlands with southern or coastal strand vegetation present such those listed below in the description of the Southern New England Level Bog. Other species include Bartonia, poison sumac, blue-joint, arrow arum, Long's bulrush and yellow-eyed grass.

Southern New England Level Bog - A shrub dominated peatland with ericads prominent. Southern and coastal strand species which characterize this community include: dwarf huckleberry, sweet pepperbush, arrow arum, Virginia chain fern, pitch pine and Atlantic white cedar.

Dry Pitch Pine/Red Pine Transitional Oak Forest - Pine dominated forests on glacial outwash plain features such as eskers, kames and moraine deposits. Pitch pine, red pine and white pine may all be present in quantity. Red oak is also present but is often less abundant than the pines. Southern species are lacking. Understory vegetation consists of several heath shrubs and limited herbacious flora.

Northern New England Acidic Rocky Summit/Rock Outcrop Community - Rocky summits and rock outcrops on high elevation or otherwise cool northern exposures of the northern hardwood and spruce-fir zones. Species usually present include: hairgrass, three-toothed cinquefoil, Rand's goldenrod, highland rush, velvet-leaved blueberry and scattered taller trees and shrubs such as mountain ash, red spruce and balsam fir. This community is distinguished from the various northern rocky summit woodlands by having less than 25 percent tree cover over a substantial area (2+ acres).

Dry Rich Appalachian Oak-Hickory Forest - An uncommon oak-hickory forest type of the central hardwood zone of southern New Hampshire, characterized by southern species and typically found on southern aspects of steep, often ledgey slopes. Sites are often shallow to bedrock, dry to dry-mesic, have a shallow litter layer and higher than average nutrient availability than other oak-hickory forests. Tree species include: black oak, red oak, white oak, chestnut oak, scarlet oak, shagbark hickory, sweet pignut, pignut hickory, and occasional hemlock and white pine. Plants which are indicative of this nutrient status and/or distinguish it from other oak-hickory forests include ebony spleenwort, blunt-lobed hepatica, late purple aster, sicklepod, downy foxglove, Virginia bush clover, hoary mountain mint, smooth-forked chickweed, rue-anemone and blunt-lobed woodsia.

The list of threatened plant species and exemplary natural communities contains documented and historical occurrences of the species and is by no means a complete representation of the species limitations. Documented species could be found in other locations within the watershed, as could other undocumented rare, threatened or endangered species. The continued existence of these species and communities within the Souhegan River watershed depends on the conservation of their habitats. The general locations of these species and ecological communities is depicted on Map II-6, Threatened or Endangered Species.

The grasses shrubs and trees found in the River corridor perform many important functions. First, they provide habitat for a diversity of wildlife species. Second, they stabilize the soil and buffer the impact of rain thereby aiding in the prevention of soil erosion. Third, they provide a vegetative buffer that filters nutrients and sediments from runoff while decreasing the velocity of flow. Fourth, they provide an effective screen

between surrounding land uses and the River. And lastly, maintenance of a vegetative buffer preserves the natural setting and the aesthetics of the river bank.

Table II-5, Threatened and Endangered Species, lists the threatened and endangered plant and animal species in the River corridor.

TABLE II-5

SOUHEGAN RIVER WATERSHED

THREATENED AND ENDANGERED SPECIES

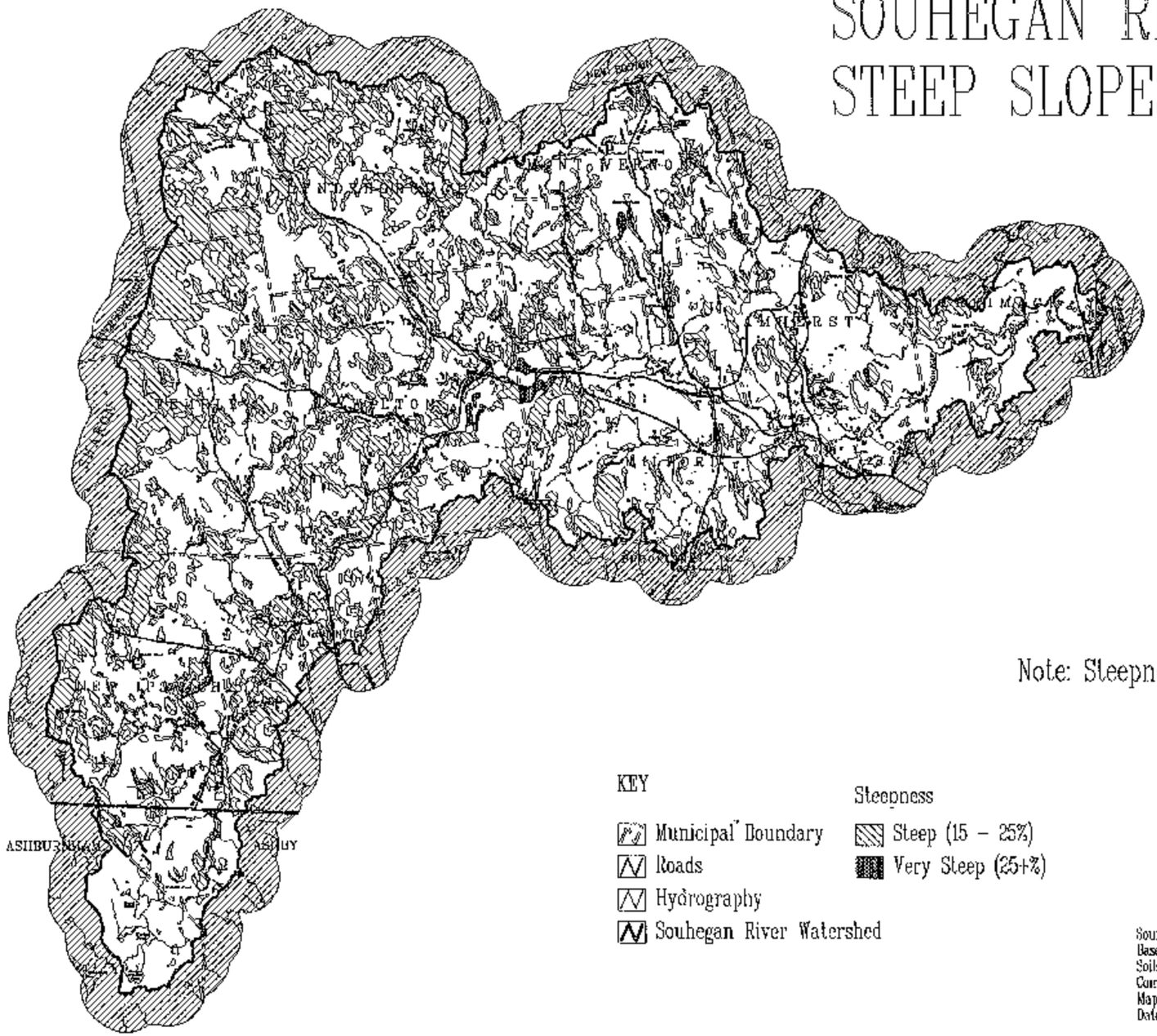
Rank		Common Name	Rank		Common Name
G3G4	S1	Long's Bitter Cress	G5	S1	Maryland Tick-trefoil
G5	S1	Wild Lupine	G4	S3	Blanding's Turtle
G5	S2	Bird's-foot Violet	G5	S3	Spotted Turtle
G5	S2	Siberian Chives	G4G5	S1	Northern Blazing Star
G5	SH	Wild Garlic	G5	S2	Sweet Goldenrod
G5T5	S2	Skydrop Aster	G5	S3	Fall Witch Grass
G5	S1	Goat's Rue	G5	S2	Blunt-leaved Milkweed
G?	SH	Stiff Tick-trefoil	G5	S1	Virginian Mountain Mint
G5	S3	Eastern Hognose Snake	G5	S3	Burgrass
G5	S2	Banded Sunfish	G5	S1	Butterfly Weed
G5	S1	Woodhouse's Toad	G5	S1	Slender Bush-clover
G5	S2	Giant Rhododendron	G5	S1	Marbled Salamander
G5	S4	Blue Spotted Salamander	G5	S3	Great Blue Heron
G5	SH	Wild Sienna	G4	S1	Climbing Fumitory
	S1	Dry Rich Appalachian Oak-Hickory Forest			
	S4	No. New England Acidic Rocky Summit/Rock Outcrop Community			
	S1	Dry Pitch Pine/Red Pine Transitional Oak Forest			
	S1	So. New England Level Bog			
	S?	So. New England Acidic Level Fen			
	S2	So. New England Floodplain Forest			
	S?	So. New England High-energy Riverbank Community			

Ranking System contained in Appendix A.

#500F-1

MAP II-1

SOUHEGAN RIVER WATERSHED
STEEP SLOPES



Note: Steepness is based on SCS soil classification

KEY

- Municipal Boundary
- Roads
- Hydrography
- Souhegan River Watershed

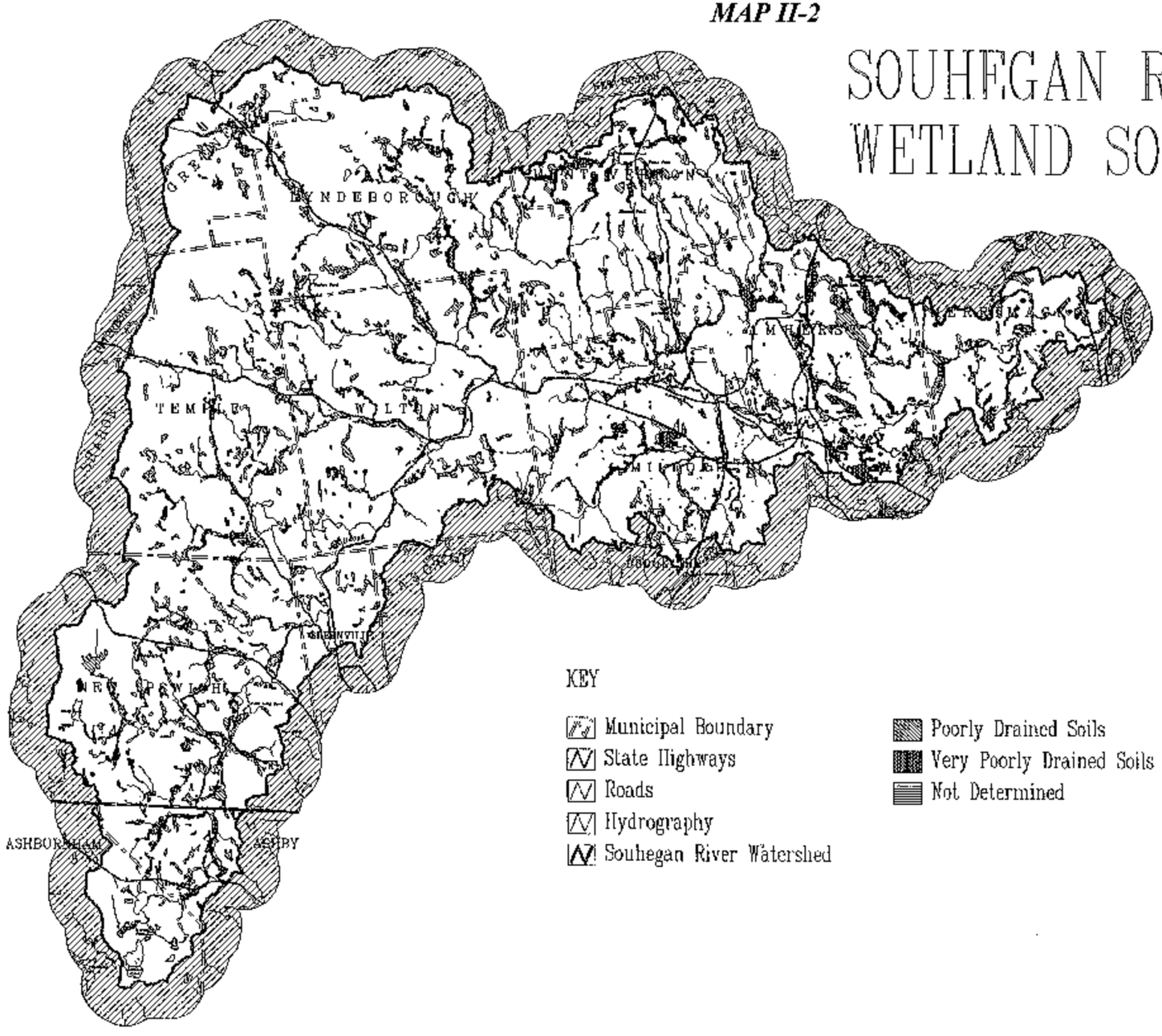
Steepness

- Steep (15 – 25%)
- Very Steep (25+%)

Source: Data prepared by NH Department of Environmental
Based on 1:24000 USGS DLGs as prepared by UNH Complex Systems Research Center.
Soils data from Hillsborough County Soil Survey as prepared by UNH
Complex Systems Research Center.
Map prepared by the Nashua Regional Planning Commission.
Date Created: Oct. 30, 1992. Date Printed: July 11, 1994.

MAP II-2

SOUHEGAN RIVER WATERSHED WETLAND SOILS



KEY

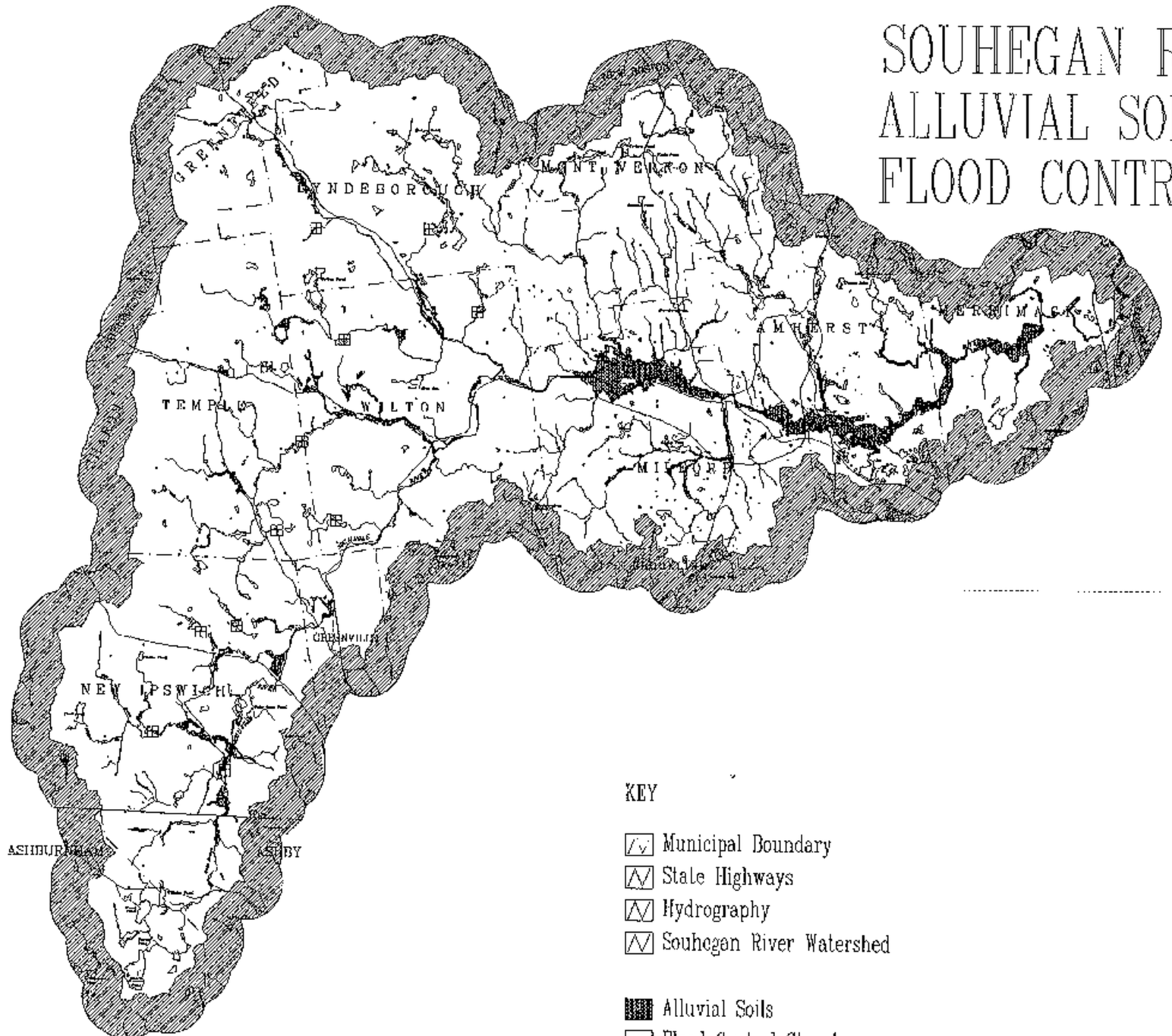
- Municipal Boundary
- State Highways
- Roads
- Hydrography
- Souhegan River Watershed
- Poorly Drained Soils
- Very Poorly Drained Soils
- Not Determined

Source: Data prepared by NH Department of Environmental Services
Based on 1:24000 USGS DLGs as prepared by UNH Complex Systems Research Center.
NH Soils data from Hillsborough County Soil Survey.
Prepared by UNH Complex Systems Research Center.
Ashburnham wetlands data from Upper Naukeag Lake Water
Supply Watershed Resources Protection Plan, April 1993.
Ashby wetlands data from Soil Conservation Service, Holden, MA.
Map prepared by the Nashua Regional Planning Commission.
Date Created: Oct. 30, 1992. Date Printed: July 8, 1994.

#500F-6

MAP II-3

SOUHEGAN RIVER WATERSHED ALLUVIAL SOILS & FLOOD CONTROL STRUCTURES



N

KEY

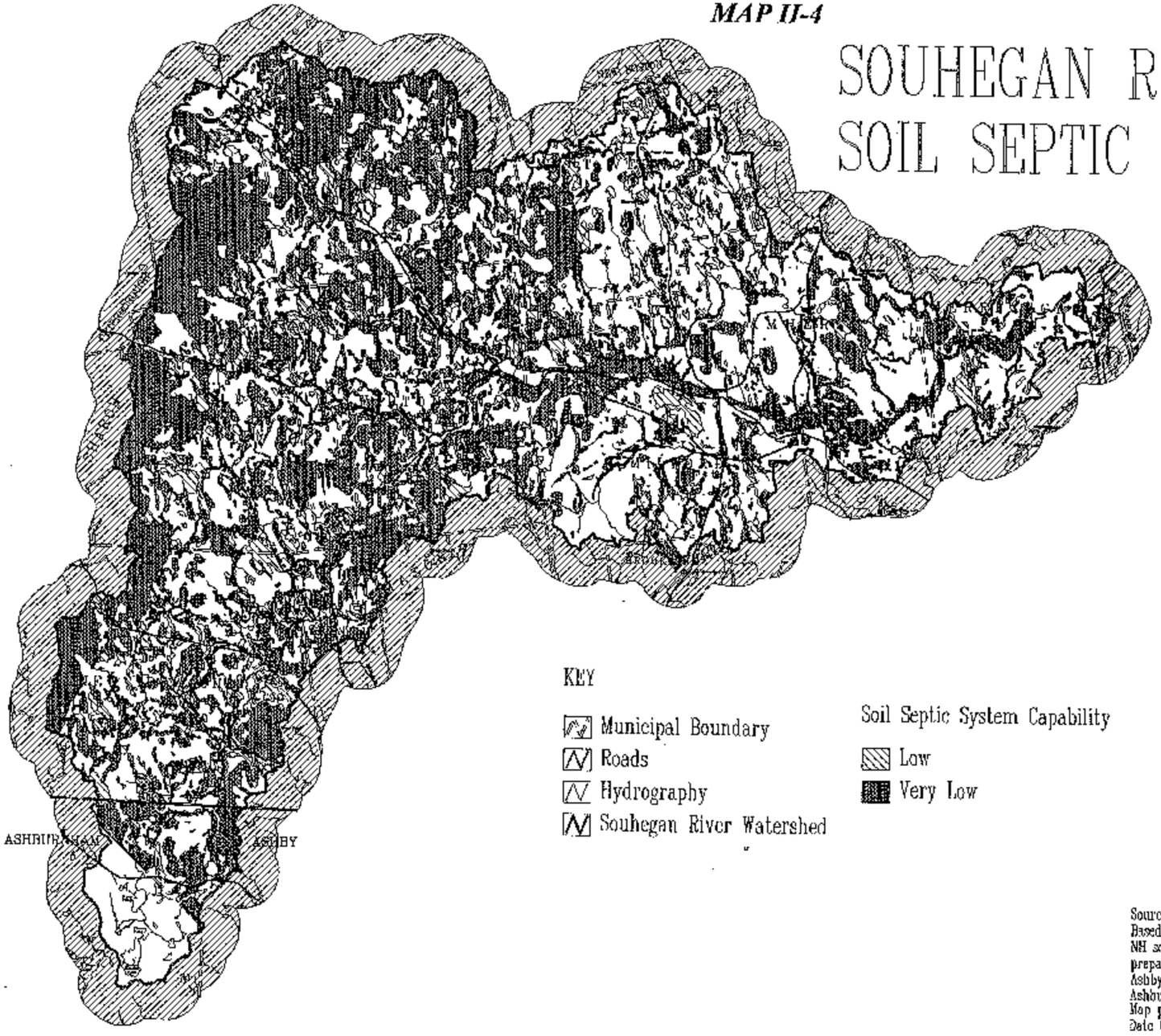
- Municipal Boundary
- State Highways
- Hydrography
- Souhegan River Watershed
- Alluvial Soils
- Flood Control Structure

Source: Data prepared by NH Department of Environmental Services based on 1:24000 USGS DLGs as prepared by UNH Complex Systems Research Center.
NH soils data from Hillsborough County Soil Survey as prepared by UNH Complex Systems Research Center.
Ashby soils from USDA, Soil Conservation Service, Holden, MA. Ashburnham soils not available.
Map prepared by the Nashua Regional Planning Commission.

#500F-14

MAP II-4

SOUHEGAN RIVER WATERSHED
SOIL SEPTIC SYSTEM CAPABILITY



KEY

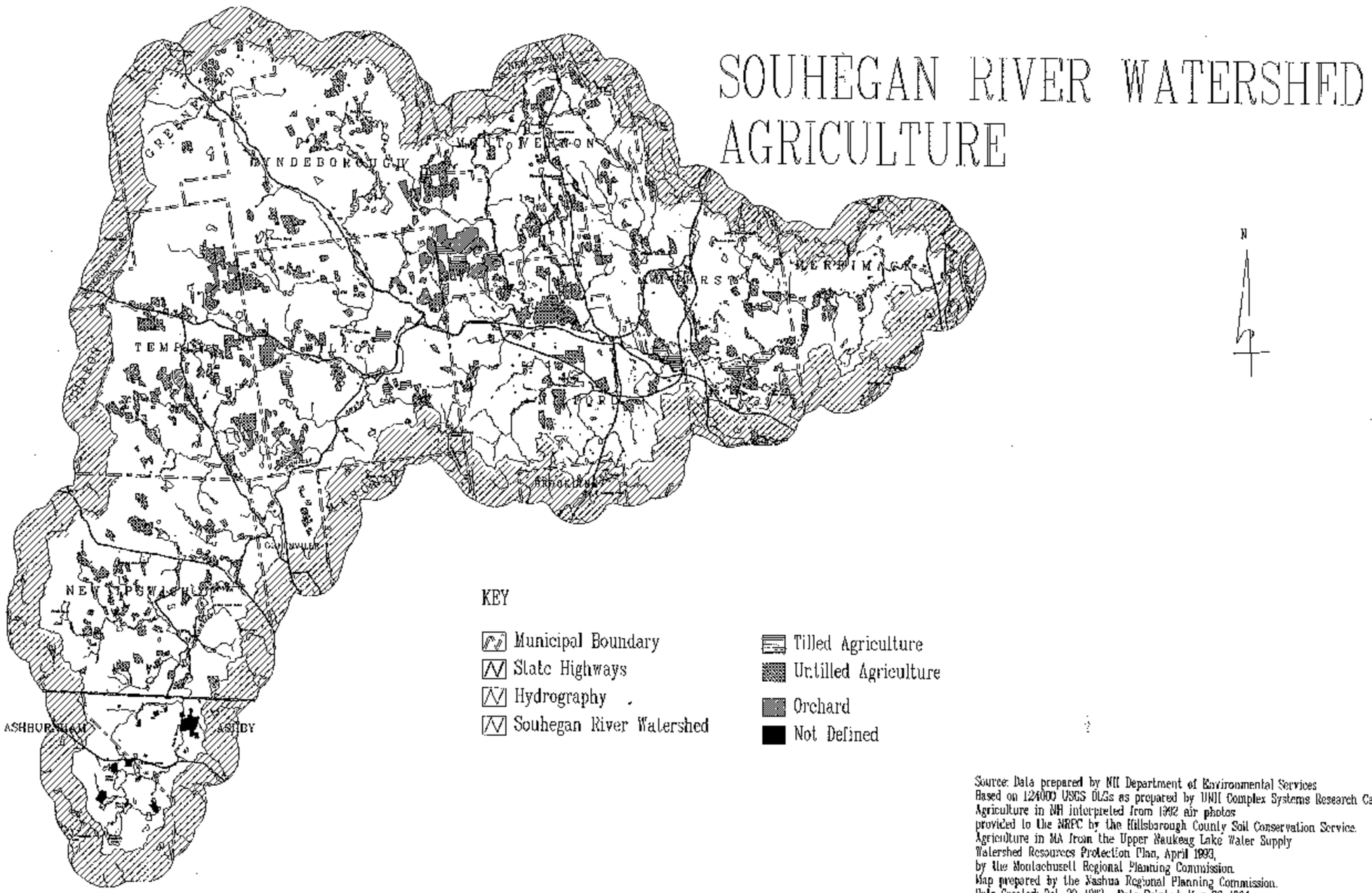
- Municipal Boundary
- Roads
- Hydrography
- Souhegan River Watershed

Soil Septic System Capability

- Low
- Very Low

Source: Data prepared by NH Department of Environmental Services
Based on 124000 USGS DLGs as prepared by UNH Complex Systems Research Center.
NH soils data from Hillsborough County Soil Survey as
prepared by UNH Complex Systems Research Center.
Ashby soils from Soil Conservation Service, Holden, MA.
Ashburnham soils data not available.
Map prepared by the Nashua Regional Planning Commission.
Date Created: Oct. 30, 1992. Date Printed: July 12, 1994.

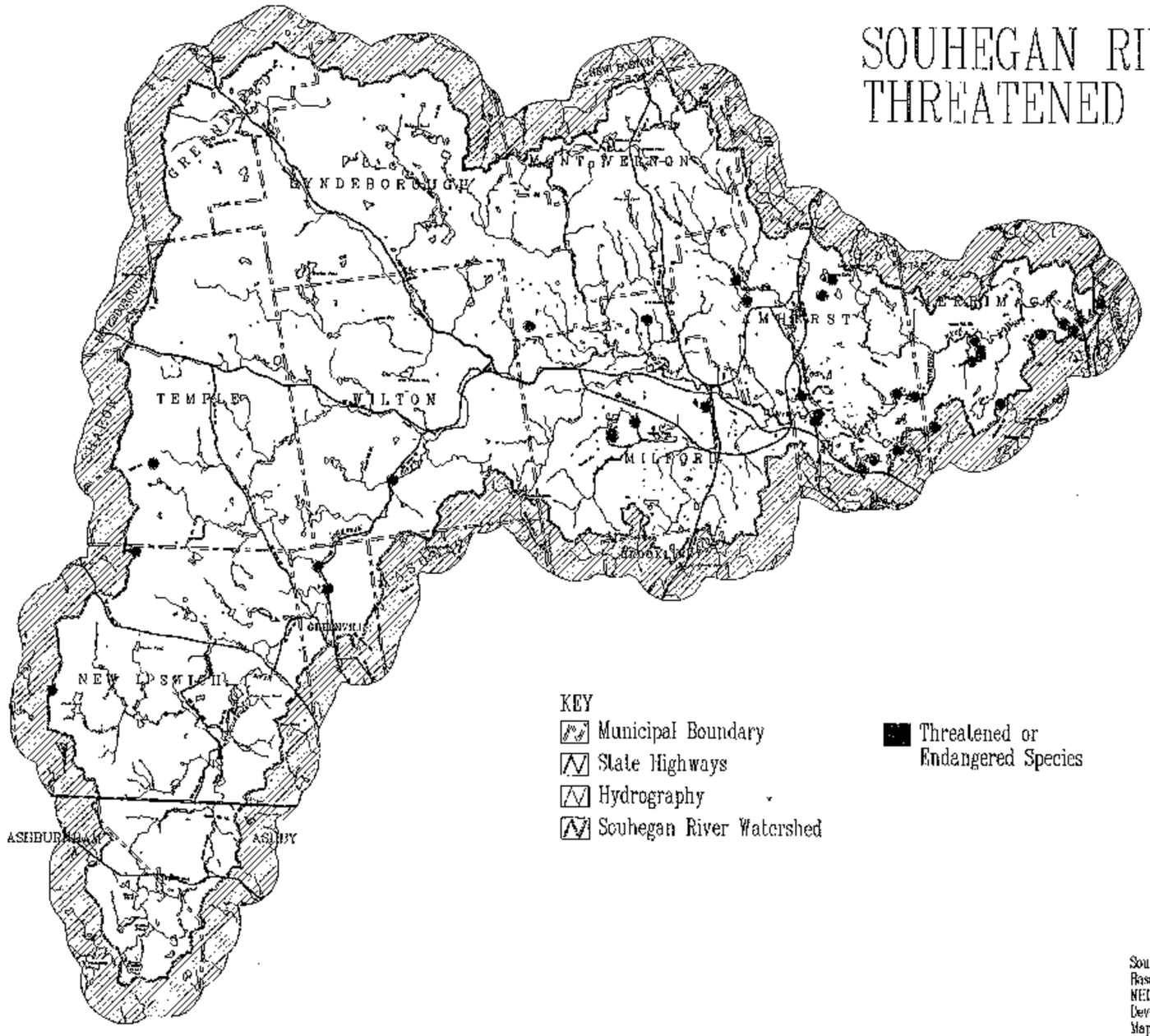
MAP II-5



Source: Data prepared by NH Department of Environmental Services
Based on 124000 USGS DLGs as prepared by UNH Complex Systems Research Center.
Agriculture in NH interpreted from 1992 air photos
provided to the NRPC by the Hillsborough County Soil Conservation Service.
Agriculture in MA from the Upper Naukeag Lake Water Supply
Watershed Resources Protection Plan, April 1993,
by the Montachusett Regional Planning Commission.
Map prepared by the Nashua Regional Planning Commission.
Date Created: Oct. 30, 1992. Date Printed: May 26, 1994.

MAP II-6

SOUHEGAN RIVER WATERSHED THREATENED OR ENDANGERED SPECIES



KEY

- Municipal Boundary
- State Highways
- Hydrography
- Souhegan River Watershed
- Threatened or Endangered Species

Source: Data prepared by NH Department of Environmental Services
Based on 1:24000 USGS DLGs as prepared by UNH Complex Systems Research Center.
NHI data from the Department of Resources and Economic
Development, digitized by UNH Complex Systems Research Center.
Map prepared by the Nashua Regional Planning Commission.
Date Created: Oct. 30, 1992. Date Printed: June 23, 1994.

#500F-7

SECTION III:

WATER RESOURCES

SECTION III: WATER RESOURCES

The Souhegan River is formed by the convergence of the South Branch and the West Branch Souhegan Rivers in New Ipswich. From there it flows northeast to its confluence with the Merrimack River in Merrimack. Major tributaries to the Souhegan River include: Furnace Brook, Temple Brook, Blood Brook, Stony Brook, Purgatory Brook, Tucker Brook, Great Brook, Beaver Brook and Hartshorn Brook. The 171 square mile watershed includes portions of the following towns: New Ipswich, Temple, Greenfield, Lyndeborough, Wilton, Greenville, Mont Vernon, Milford, Amherst and Merrimack in New Hampshire and Ashby and Ashburnham in Massachusetts.

As a multiple-use river, the Souhegan River supports a number of uses such as wastewater assimilation, irrigation, recreation, hydropower, fisheries and wildlife. The capacity of the Souhegan River to sustain these numerous and competing uses is limited. A balance between the many uses and users of the watershed resources must be attained to insure the continuation of the multiple use capabilities of the Souhegan River.

The physical and natural characteristics and functions of the Souhegan River watershed have been discussed in Section II. This section will focus specifically on the water issues related to the River and its watershed, including water resources, water quality, water supply and hydropower.

WATER RESOURCES

The water resources in the Souhegan River watershed form an extensive network of streams, lakes, ponds, wetlands and groundwater. Actions affecting these areas such as chemical contamination, damming or dredge and fill may ultimately have an impact on the River. This section briefly discusses the major tributaries, ponds, wetlands and groundwater resources in the Souhegan River watershed.

Tributaries

The Souhegan River watershed contains numerous tributary streams of varying sizes. These streams form an interconnected network which perform many functions such as providing fisheries and wildlife habitats, conveying floodwaters, supplying water for industrial and irrigation uses, providing recreational opportunities and presenting scenic views. Because of this interconnected relationship, any activity with a negative impact on a stream, such as a chemical spill or an erosion problem may result in a corresponding negative impact on the stream or river into which it flows. Likewise, any positive impact on the stream, such as the elimination of leachate from malfunctioning septic systems, will have an overall positive impact on the receiving water. Therefore, the activities that take place within the Souhegan River watershed have a direct impact on the quality and the quantity of surface water and groundwater in the watershed.

There are twelve major tributaries to the Souhegan River. Furnace Brook originates in New Ipswich and flows approximately 3.2 miles east to the Souhegan River near the Greenville line. Temple Brook originates in southeast Temple and flows approximately 4.2 miles northeast to West Wilton where it converges with Blood Brook. Blood Brook flows approximately 7 miles southeast from Sharon through Temple to West Wilton where it converges with Temple Brook to form Gambol Brook which flows into the Souhegan River. Mill Brook, the only Class A water in the watershed, originates in Temple and flows 7.4 miles through Wilton to its convergence with Stony Brook. Stony Brook, approximately 9.6 miles, rises in the hills of Lyndeborough, flows west into Greenfield and swings back southeast through Lyndeborough into downtown Wilton where it converges with the Souhegan River. Purgatory Brook originates in Mont Vernon and flows approximately 5.7 miles south to the Souhegan River in Milford. Tucker Brook originates in a wetland in southeast Wilton and flows approximately 4.5 miles northeast to its convergence with the Souhegan River in Milford. Caesar's

Brook originates at Jew Pond in Mont Vernon and flows approximately 2.5 miles into Amherst where it joins with Beaver Brook. Beaver Brook starts in the Mont Vernon hills and flows approximately 7.7 miles through Mont Vernon and Amherst before converging with the Souhegan River. Great Brook, which is contained entirely within Milford, originates in the southern Milford hills and flows approximately 4.4 miles through Osgood Pond and into the Souhegan River. Hartshorn Brook starts at the outlet of Stearns Pond in Mont Vernon and flows 3.2 miles through Mont Vernon and Milford before converging with the Souhegan River. The characteristics of the major tributaries to the Souhegan River are summarized in Table III-1.

TABLE III-1
SOUHEGAN RIVER WATERSHED
MAJOR TRIBUTARIES

Stream Name	*Length in Miles*	*Free-flowing or Dammed*	*Legislative Classification*
S. Branch Souhegan R.	4.0	dammed	B
W. Branch Souhegan R.	2.0	dammed	B
Furnace Brook	3.2	dammed	B
Temple Brook	4.2	dammed	B
Blood/Gambol Brook	7.0	dammed	B
Stony Brook	9.6	dammed	B
Mill Brook	7.4	dammed	A
Purgatory Brook	5.7	free-flowing	B
Tucker Brook	4.5	free-flowing	B
Caesar's & Beaver Brk.	7.7	free-flowing	B
Great Brook	4.4	dammed	B
Hartshorn Brook	3.2	dammed	B

Lakes and Ponds

Many small ponds and water bodies exist in the Souhegan River watershed. The majority of the ponds are less than 10 acres in size and are associated with wetland systems or tributary streams. Information on these small ponds is limited since state efforts are directed to the larger ponds which provide greater opportunities for public use. The 1992 New Hampshire Water Quality Report to Congress - 305(b) Report and the Massachusetts Water Quality Report to Congress - 305(b) Report contain a listing of the significant lakes in each state. A significant lake is defined in New Hampshire as:

> "Any freshwater lake or pond that has a surface area of 10 or more acres, is not private, and does not prohibit recreational activity. It includes both natural and man-made lakes. Significant lakes do not include saltwater ponds, public water supplies, wetlands or river impoundments (unless the impoundment functions as a lake both hydrologically and recreationally) . . ."

A list of the significant lakes, private ponds and river impoundments in the watershed is provided in Table III-2. Lakes and ponds not contained in the 305(b) Reports were identified on the USGS quadrangle maps for the watershed area.

The 305(b) Report also evaluates the trophic class of the significant lakes. The trophic classification system consists of four criteria used to measure the biological production of a lake as a result of both nutrient input and

lake aging. Eutrophic lakes tend to be older lakes which have a high quantity of available nutrients and large quantities of submerged and emergent vegetation; however, young lakes with significant inputs from human activities could also be classified as eutrophic. These lakes tend to be shallow and are more suitable for warm water fish species such as large-mouth bass and sunfish. Oligotrophic lakes tend to be younger lakes which have a low quantity of available nutrients and scant quantities of submerged and emergent vegetation. These lakes tend to be deeper and are more suitable for cold water fish species such as trout and salmon. Mesotrophic lakes have features with values between those of oligotrophic lakes and eutrophic lakes. The information on trophic class for the lakes and ponds in the watershed is listed in Table III-2, when known, along with information on area and location. When one or more attributes are not known, the designation N/A appears.

TABLE III-2

SOUHEGAN RIVER WATERSHED

SIGNIFICANT LAKES AND PONDS

Lake or Pond Name	*Size in Acres*	*Trophic Class*	*Municipality*
Honey Pot Pond	12	Eutrophic	Amherst
Little Baboosic Pond	15	N/A	Amherst
Osgood Pond	20	Eutrophic	Milford
Horton's Pond	14	Eutrophic	Mont Vernon
Badger Pond	12	N/A	Lyndeborough
Putnam Lake	50	N/A	Lyndeborough
Burton Pond	26	N/A	Lyndeborough
Water Loom Pond	46	Eutrophic	New Ipswich
Wheeler Pond	N/A	N/A	New Ipswich
Pratt Pond	19	N/A	New Ipswich
Ward Pond	54	N/A	Ashburnham
Marble Pond	17	N/A	Ashburnham
Watatic Pond	25	N/A	Ashburnham
Stodge Meadow Pond	124	N/A	Ashburnham

Sources: New Hampshire Water Quality Report to Congress (305-B), 1992 and USGS Ashburnham Quadrangle

Local regulations directly related to the protection of surface waters in the watershed are limited. Amherst, Merrimack, Milford, New Ipswich and Ashburnham are the only communities that specifically regulate the use of land adjacent to surface waters. The towns of Greenfield and Wilton provide some additional protection for water bodies through their wetland protection ordinances by requiring increased setbacks for leachfields and septic systems from water bodies and watercourses. Greenfield requires all septic tanks and leachfields be set back 125 feet from a wetland, water body or watercourse, while Wilton's setbacks are based on the permeability of the receiving soil and range from 75 to 125 feet. Greenville, Lyndeborough, Merrimack, Mont Vernon and Temple, New Hampshire and Ashby, Massachusetts have no specific provisions for the protection of surface waters.

Amherst's watershed protection district establishes a 100 foot buffer along all surface water bodies, and perennial and intermittent streams within which no buildings or septic systems can be located. Permitted uses within the district are limited to: trimming, pruning and thinning of vegetation according to forestry best management practices (BMPs); tree farming, timbering and forestry in accordance with BMPs; wildlife refuges; wharves, boat houses, footbridges or similar structures normally associated with use in or near the water; and amateur, non-profit sports and recreation uses subject to Planning Board site plan approval. The following surface waters are included in Milford's wetland conservation district: Souhegan River, Great Brook, Tucker Brook, Birch Brook, Purgatory Brook, Compressor Brook, Hartshorn Brook, Ox Brook, Mitchell Brook and Spaulding Brook, and

Osgood, Railroad, Hartshorn, and Compressor ponds. The district establishes a 50 foot buffer from the recognized edge of the water body or water course in which no construction or ground disturbance shall occur. Activities permitted within the buffer include: conservation areas, nature trails and wildlife refuges; parks and recreational uses consistent with the purpose of the district; open space; forestry and tree farming in accordance with BMPs; agriculture including growing and harvesting of crops; buildings and structures that do not require a building permit; decks raised above the ground; and monitoring and water supply wells. The New Ipswich Zoning Ordinance establishes a 100 foot setback for structures, parking lots and leachfields from the normal bank of all lakes, ponds, rivers, streams and brooks. Docks, boat landings, boat houses and saunas are exempt from the setback. The Ashburnham Zoning Bylaws establish a Wetland and Watershed Protection District which regulates land uses within and establishes setbacks from the major wetland areas and undeveloped shoreline portions of the lakes and ponds in the community. New residential, commercial and industrial uses are prohibited in the District, but some institutional and agricultural uses are permitted. The required setbacks vary depending on the land use.

Groundwater

Stratified drift aquifers have been the focus of groundwater investigations in the northeast United States because of their ability to store and rapidly transmit large volumes of water. Stratified drift deposits are composed of sand and gravel that have been sorted and deposited by glacial meltwaters. Extensive, coarse deposits of stratified drift can store large volumes of water. The storage capacity of the aquifer is directly related to the size of the soil particles and the degree of sorting. The high porosity of the coarse grained aquifers allows groundwater to flow through quite readily. Porosity in a well sorted aquifer is greater than in a poorly sorted aquifer; thus, a coarse grained, well sorted aquifer has greater area for water storage. In addition, the larger pore size allows water to be transmitted more easily and therefore increases the speed of water withdrawal.

In 1987, The United States Geological Survey (USGS) completed a study of stratified drift aquifers in the NRPC region entitled Hydrogeology of Stratified Drift Aquifers and Water Quality in the Nashua Regional Planning Commission Area. The study identified the location and extent of stratified drift aquifers in the NRPC region. The Souhegan River flows through stratified drift deposits from the Merrimack River west to the Wilton-Greenville Town line, the western limit of the USGS study. The stratified drift deposits in Merrimack are composed mostly of fine grained materials with some coarse grained deposits located along the Amherst border with transmissivities of less than 2,000 sq. ft./day. In Amherst, the river flows through coarse grained stratified drift overlaying fine grained stratified drift. Materials in this area consist principally of medium to coarse sand 10 to 30 feet thick overlaying significant thicknesses of clay, silt and fine sand. Transmissivities in this section range from less than 2,000 to 8,000 sq. ft./day with much of the corridor in the 6,000 to 8,000 sq. ft./day range. From the Amherst-Milford border west to the Wilton-Greenville border, the stratified drift deposits are predominantly coarse-grained with some small sections of coarse-grained stratified drift overlaying fine-grained stratified drift in Milford. Coarse-grained stratified drift consists principally of medium sand to cobble gravel. Again, transmissivities in this section range from less than 2,000 to 8,000 sq. ft./day. Detailed information for Greenfield, Temple, Greenville and New Ipswich is not yet available from the USGS; however, a 1977 study by John Cotton, *Availability of Ground Water in the Lower Merrimack River Basin, Southern New Hampshire*, provides a preliminary assessment of groundwater availability in these towns. The study indicates limited deposits of thin, medium to coarse grained sand or sand and gravel with a medium potential to yield water. Stratified drift deposits in the watershed are depicted on Map III-1. It should be noted that although the USGS aquifer maps are more detailed than any previous investigations, they present generalized areas of expected high yield and low yield. Isolated areas of contrast to the prevailing aquifer type can be expected but will only be discovered by exploratory well drilling.

The most significant stratified drift deposits are located along the River corridor in Amherst and Milford. The Amherst aquifer along the Souhegan River extends from Merrimack to Milford. The central part of the aquifer is composed of 25 feet of coarse-grained material underlain by 75 feet of fine-grained materials. Transmissivity is

greater than 8,000 sq. ft./day throughout this area. Two of Milford's municipal water supply wells are located in this aquifer with average yields of 400 and 700 gal/min. respectively. The most productive aquifer in Milford is located in the central portion of the study corridor. Transmissivity in this portion of the aquifer exceeds 8,000 sq. ft./day. Six high yield wells with sustained yields of 200 to 500 gal/min. are located in this area, Milford's Savage and Keyes wells, the Milford fish hatchery well and three industrial wells. Potential exists for further siting of municipal well supplies in both aquifer areas. In addition, Wilton's two municipal water supply wells are located in the corridor as are the Monadnock Spring Water Company wells.

Stratified drift deposits located in the surrounding watershed tend to be discontinuous and shallow when compared to those within the River corridor. These relatively small stratified drift deposits are located in the towns of New Ipswich, Temple, Greenfield, Lyndeborough, Wilton, Mont Vernon, Amherst and Milford. Lyndeborough is typical of the upland region watershed towns in the nature of its stratified drift deposits, according to the Water Resources Inventory for the Nashua Region, produced by the Nashua Regional Planning Commission in 1989, only 2.4 square miles or eight percent of the town is underlain by stratified drift deposits. The deposits are widely scattered and thin, with most occurring in the tributary stream valleys. These small aquifers, generally having saturated thicknesses of less than 20 feet and transmissivity values of less than 2,000 sq. ft./ day, are best suited for individual household water supplies.

Wilton has somewhat more significant groundwater resources than Lyndeborough and the other upland towns, largely due to the presence of several major tributary streams converging with the Souhegan River within the town. The most significant of these stratified drift aquifers is found along Blood Brook and Stony Brook. Saturated thickness and transmissivity values for the Blood Brook and Stony Brook aquifers are 80 feet and 4-8,000 sq. ft./day and 40 feet and 4-8,000 sq. ft/day, respectively.

The remaining stratified drift aquifers of any significance in the watershed tend to be continuous with the extensive regional aquifer system which extends from Wilton to Merrimack, previously described. These aquifers are centered on tributary streams, and the areas of greatest saturated thickness and transmissivity are often found near the tributary's confluence with the Souhegan River. The most prominent of these are the Beaver Brook aquifer in Amherst , with a saturated thickness in the range of 70 feet and a transmissivity of approaching 8,000 sq. ft/day, and the Great Brook aquifer in Milford, which has several areas with transmissivities approaching 8,000 sq. ft/day.

The portion of the watershed located in the Massachusetts towns of Ashburnham and Ashby have, relatively small, scattered stratified drift deposits, due to the rugged, upland nature of the terrain. It is important to note that even small, limited areas of stratified drift are an important resource, and protecting these aquifers can only help to preserve the water quality of the entire watershed and the Souhegan River.

Land use can have a significant impact on groundwater quality. Groundwater can be contaminated by a number of activities such as leaking underground storage tanks, failed septic systems, leachate from chemical and solid waste sites, improper applications of pesticides and accidental spills. A small leak of a few gallons can contaminate millions of gallons of drinking water. Milford and Merrimack have first hand experience with groundwater contamination which has required the closure of municipal water supply wells in each community.

Merrimack, Amherst, Milford and Wilton have established aquifer protection districts to protect their groundwater resources. The regulations generally define the district, specify permitted and prohibited uses, establish performance standards, and address nonconforming uses and incorrectly designated areas. Wilton, Milford and Amherst use the maps from the 1987 USGS study to define the district boundaries and Amherst includes mapped primary and secondary recharge areas in its definition. Merrimack's district boundary is based on a 1988 study by Whitman and Howard entitled Aquifer Conservation District and divides the district into three areas the aquifer/primary recharge area, the secondary recharge area and the balance of the watershed. New Ipswich

regulates the drilling of commercial high yield wells so as not to deplete the local groundwater resource on which all residences in town depend. This ordinance is concerned with preventing groundwater depletion rather than groundwater contamination, and no district boundaries or special regulations are specified.

Uses typically permitted in the aquifer protection districts include those which pose a minimal threat to groundwater such as: industrial or commercial uses which discharge no non-human wastes on-site; industrial uses that discharge only noncontact cooling water; residential development; farming, gardening, nurseries, forestry, harvesting and grazing provided that fertilizers, herbicides, pesticides and other leachables are used appropriately and are not stored outdoors; activities designed for conservation of soil, water, plants and wildlife; outdoor recreation, nature study, boating, fishing and hunting where otherwise legally permitted; foot, bicycle and/or horse paths and bridges; and maintenance and repair of existing structures. Prohibited uses generally include those which pose a significant threat to the groundwater resource such as: disposal of solid waste; subsurface storage of petroleum products except under specific conditions; disposal of liquid or leachable non-human wastes except from one or two family residences; discharge of contact type process waters on-site; commercial animal feedlots; automotive service and repair shops, junk and salvage yards; bulk storage of toxic materials for resale or distribution; on-site handling, disposal, storage, processing or recycling of hazardous or toxic materials; outside unenclosed storage of road salt; and dumping of snow containing de-icing chemicals brought from outside the district.

As depicted on Map III-1, the Souhegan River flows through some of the most significant stratified drift deposits in the region. The characteristics that make these areas good sources of water also suggest that contaminants could readily be transmitted from groundwater to surface water and vice versa. The negative impacts of this relationship can be profound. Chemicals reaching surface waters can impact fish and wildlife species, and threaten human health. A fish kill can result from just one incident while the impacts of other contaminants can only be assessed over time.

WATER QUALITY

Two major types of pollution impact the water quality of the Souhegan River watershed, point sources and nonpoint sources (NPS). Point sources of pollution include discharges from one identifiable source such as a pipe. All point sources of pollution that discharge directly to surface waters are required to obtain a permit under the National Pollutant Discharge and Elimination System (NPDES). NPDES permits specify effluent limitations, compliance schedules and monitoring and reporting requirements. Under the NPDES process, discharges are categorized as municipal or industrial and classified as major or minor. A major municipal discharge would have one of the following characteristics: 1) a flow equal to or greater than 1 million gallons per day, 2) an impact on downstream uses, and/or 3) discharge upstream of a public water supply. The classification of major industrial discharges is based on a more complex point system that considers toxic pollutant potential, wastewater flow rate, type of wastewater (non-contact cooling water or process water for example), amounts of conventional pollutants, heat load, presence of downstream water supply and water quality limitations of the receiving water.

Nonpoint sources of pollution are not easily identified and in many instances originate from more than one source. The primary categories of NPS in order of concern as listed in the New Hampshire Nonpoint Source Pollution Management Plan, 1989, are: landfills, construction activities, subsurface disposal systems, junkyards, urban runoff, sludge and septage disposal sites, agriculture, silviculture and road salt. The complexity of determining the source of NPS pollution makes it difficult to regulate.

The Souhegan River and all of its tributaries have a legislative classification of Class B except for the Mill Brook system in Wilton which is identified as a Class A water. Class B waters are considered acceptable for primary contact recreation (swimming), fishing and municipal water supplies, after adequate treatment. Class A waters are of the highest quality and are acceptable for water supplies after adequate treatment. For example, Mill Brook

in Wilton flows into the Wilton reservoir which historically served as the Town's water supply. Note, that the legislative water quality classification is essentially a goal; this does not mean that a particular surface water meets the water quality standards for its legislative classification. All surface waters in New Hampshire are either Class A or Class B.

Based on samples collected in 1990, 1991 and 1992 by the Department of Environmental Services (DES), the 1992 New Hampshire Water Quality Report to Congress - 305(b) found that of the 34 miles of the Souhegan River, 8 miles either did not support or only partially supported the River's Class B classification. A total of six miles did not support Class B standards because of bacteria violations and two miles only partially supported the standard because of dissolved oxygen and cadmium violations. It should be noted that if a site were monitored three times and violated the bacteria standards once the entire segment would be considered nonsupporting. The 305(b) report recommends further investigation to determine the source of the problem. The 1994 Section 305(b) Water Quality Report reported only a one mile segment, near the NH Route 13 bridge in Milford, as not supporting the standard for bacteria. Again, the probable source is not known and the 305(b) report recommends further study to determine the source.

In addition to the testing done by the DES, the Merrimack River Watershed Council's (MRWC) citizen monitoring program samples eleven sites on the Souhegan River at the locations indicated on Map III-2. Seven of the sites are in the same location as the sites monitored by the DES to permit comparison of the DES and MRWC data. Water quality samples were gathered by volunteers during the summers of 1991, 1992, 1993 and 1994. All of the samples were analyzed for E. coli bacteria and dissolved oxygen; while the 1992, 1993 and 1994 samples were also tested for total phosphorous. The bacteria and dissolved oxygen tests are used to determine if the water quality in the river meets the standards established for Class B waters. Total phosphorous is an indicator of nutrient enrichment in fresh waters. The water quality data were first analyzed by laboratory staff and then reviewed and discussed by a panel of water quality experts.

Eight, bi-weekly samples were collected from July 1 to October 14 during the 1992 sampling season. A total of 53 samples were collected and analyzed for bacteria, 50 contained bacteria colonies less than the instantaneous water quality standard of 406 colonies per 100 ml for Class B waters and three exceeded the standard. Sixty-six samples were collected and analyzed for dissolved oxygen. Of those, 53 had dissolved oxygen levels which exceeded the State's 75% saturation standard; however, each site did not meet the 75% saturation standard at least once during the sampling season. In general, the Souhegan River meets the applicable State water quality standards for bacteria and dissolved oxygen. Class B water quality standards for designated swimming areas must not exceed a seasonal geometric mean of 126 colonies per 100 ml or an instantaneous count of 88 colonies per ml. Of the 53 samples collected, 27 violated the instantaneous standard, sites SoR50, SoR60 and SoR70 violated the standard four times and sites SoR90, SoR100 and SoR110 violated the standard three times. Four of the sites, SoR100, SoR70, SoR60 and SoR50 violated the standard for seasonal geometric mean. The conclusion is that prolonged water contact at these four sites could present a health risk. Comparing the 1991 and 1992 bacteria results reveals that six sites had lower levels in 1992 and five sites had higher levels in 1992.

Forty-four samples were collected and analyzed for total phosphorous. Of those 32 contained levels less than the 0.05 mg/l level of concern while twelve exhibited levels greater than 0.05 mg/l. The six downstream sites, SoR10-70, exceeded the 0.05 level at least once while SoR50 exceeded the level each of the four times it was sampled. The levels at the six downstream sites indicate a cause for concern about possible nutrient enrichment in the River. The New Hampshire Water Quality Standards do not contain criteria for phosphorous.

As part of the Merrimack River Water Quality Project, a biological assessment of the benthic macroinvertebrate populations of the Souhegan River was conducted in the fall of 1992. Benthic macroinvertebrates are bottom dwelling organisms such as stonefly, mayfly and caddisfly nymphs, worms, leeches, crayfish and other small organisms. The macroinvertebrate communities present and absent in a river or stream provide a good indication

of water quality since many of the species are sensitive to pollution. The diversity and numbers of species can be used to identify pollution problems and also to track long term water quality. At present, New Hampshire water quality standards do not contain criteria specifically relating to benthic macroinvertebrate populations, so guidelines developed in New York and Vermont were used in evaluating the Souhegan River.

The benthic macroinvertebrate sampling took place between October 3 and 10, 1992. Eight sites along the river were evaluated: SoR100, SoR90, SoR80, SoR70, SoR60, SoR50, SoR30 and SoR20. The health and composition of the benthic macroinvertebrate community was assessed in several ways. These methods included:

Community Composition of the Major Groups: This measures the percentage of the sample made up of each of the major groups of species from a site. Mayflies, stoneflies and caddisflies should be well represented, since they contain many pollution sensitive species. In a healthy stream, no one group of species should be found to dominate the sample. A reference or "model" community was developed for comparison purposes. This ideal or model community consists of 40% mayflies, 5% stoneflies, 10% caddisflies, 20% midges, 10% beetles, 5% worms, and 10% other.

Percent Model Affinity: This measures the percentage affinity of the sample against the distribution of major groups in the model population described above. In general, the closer the affinity of the sample to the model, the healthier the macroinvertebrate population of the stream. Greater than 64% affinity is taken to be a sign of no adverse impacts on the population, 50% - 64% affinity reflects a slight impact on the health of the population, 34% - 49% affinity indicates a moderate impact on the health of the population, and less than 35% affinity represents a severe impact to the health of the population.

Density: This refers to the total number of organisms in a sample. Nutrient rich water will tend to have a higher density of organisms, while siltation and toxic pollution will tend to reduce densities. A healthy site should have a minimum density of 150 organisms per sample.

EPT Richness: This refers to the numbers of different families found for each of the three major insect orders: Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). Generally, the greater the EPT, the better the water quality. A healthy sample should contain at least 10 families.

The composition of the river bottom is also examined, as it can have an impact on macroinvertebrate populations. Generally, the best habitat is a combination of rubble and gravel. The higher the percentage of rubble and gravel the better the habitat for macroinvertebrates.

Of the eight sites examined, macroinvertebrate habitat was not found to be ideal due to a high ratio of rubble to gravel. Rubble predominated at the upstream sites (SoR100, SoR90 and SoR80); boulders were predominant at SoR20 and SoR60; and gravel was predominant at SoR70 and SoR50. In addition, several sites were experiencing a high algae cover. Generally, an algae cover exceeding 50 percent indicates excessive nutrients in a stream. Sites SoR100, SoR70 and SoR60 had algae coverages nearing 75 percent and coverage at site SoR30 was nearly 50 percent. All other sites had less than 50% algae coverage.

The community composition of benthic macroinvertebrates was found to vary greatly from the model community. Most sites showed a poor representation of mayflies and a dominance of caddisflies. No stoneflies at all were found at sites SoR100, SoR70 and SoR50. Mayflies and stoneflies increased going downstream from SoR100 to SoR80. From SoR70 to SoR50 the samples were dominated by caddisflies. Mayflies and stoneflies return in more optimal numbers at sites SoR30 and SoR20.

The percentage of model affinity for most sites was in the moderate or severe impact range. This indicates that habitat or water quality problems could be impacting the benthic macroinvertebrate communities. Only site

SoR80 was in the no impact range, as is reflected by its 64% affinity to the model, while site SoR30 was in the slight impact range. Site SoR70 exhibited the least model affinity, with the community being composed almost entirely of caddisflies.

The specimen density at 5 of the 8 sites was well below the standard of 150 organisms per sample, indicating habitat or water quality problems. Sites SoR60 and SoR20 are dominated by boulders which could be the reason for the low density of organisms at these sites. The report states that the low densities at sites SoR100, SoR90, SoR60 and SoR30 could be due to toxic or low oxygen conditions. Sites SoR70 and SoR50 (both in Milford) had abnormally high specimen densities, possibly indicative of high nutrient loading in that part of the Souhegan River.

The EPT richness showed a low diversity of mayflies, stoneflies and caddisflies. All sites had an EPT richness below 12, which is the minimum considered for a healthy site. This could indicate a habitat problem, a limited food source, siltation problems or a water quality problem.

The report concludes that the "benthic macroinvertebrate community of the Souhegan River is generally not what it should be." The degree of variance due to human influences such as pollution and siltation, rather than poor habitat, has yet to be definitively determined. However, by correlating the other water quality data with the results of the biological study, it may be possible to identify those sections of the river most at risk or suffering from human influence, and take corrective measures to reduce the risks to the Souhegan River.

In addition to the regular testing conducted by the DES and the citizen monitoring program, the DES conducted a waste load allocation study on the Souhegan River in 1990. The Town of Amherst became concerned when the 1987 USGS aquifer study revealed that the Town's largest and most productive aquifer was zoned for industrial and commercial uses with onsite subsurface waste disposal. To protect this valuable resource, the Town began investigating options to provide wastewater treatment to the area including tying into the Milford WWTF and developing a treatment facility for the Bon Terrain industrial park with an indirect groundwater discharge adjacent to the Souhegan River. A waste load allocation study is required by the Water Quality/Permits Bureau to support a groundwater permit for an indirect discharge. The Town requested the assistance of the NH DES in conducting the wasteload allocation (WLA) study to determine the level of treatment required for the Bon Terrain facility to meet Class B water quality standards in the Souhegan River. The study was conducted to answer three questions: 1) Could Class B dissolved oxygen standards be met with the Milford Wastewater Treatment Facility (WWTF) discharging at its existing permit limits? 2) What level of treatment would be required at the proposed Bon Terrain facility in order to meet the legislatively designated Class B dissolved oxygen standards with the Milford facility discharging? and 3) What effect withdrawals would have on the water quality in the river, a historic withdrawal by Pennichuck Water Works and a proposed withdrawal by the Souhegan Regional High School?

Waste load allocation analyses are conducted to simulate the worst case situation. Therefore, the study was conducted during the summer months and assumed 7Q10 flows, the seven day low flow which occurs on the average of once every ten years. The 7Q10 flow for the Souhegan River at the gauge in Merrimack, as determined by the USGS, is 12.8 cfs. Six sites were monitored on the Souhegan River, one upstream and five downstream of the WWTF, and two sites were monitored on tributaries. The sites were sampled on two days at two flows, July 17-18 and September 4-5, 1990. The information obtained from the samples was input into a model to predict the water quality impact on the River of different discharge locations and levels.

Under current conditions and discharges from the Milford WWTF, the model indicated that Class B dissolved oxygen standards would be met for the entire downstream portion of the River. The study, however, found that under 7Q10 low flow conditions if the Milford WWTF discharged at its design capacity at its present location in accordance with its NPDES permit, the standards for Class B dissolved oxygen would not be met. Recommendations to remedy the situation included:

1) Lower the maximum discharge flow from 3.3 cfs to 1.70 cfs during summer conditions. The Milford WWTF currently discharges at about 1.30 cfs.
2) Keep the present permit limits but move the outfall to an area below Beaver Brook.
3) Lower the Milford average weekly BOD_5 from 25 to 14 mg/l.

Based on these three recommendations, the study outlined the options available for the discharge at the proposed Bon Terrain facility and the changes required in the Milford WWTF parameters, and the impact on the WWTF if the wastewater from the Bon Terrain facility were pumped to Milford. The study also concluded that if both the high school and Pennichuck Water Works withdrew water downstream of the WWTF outfall that Class B water quality standards would continue to be met downstream of Boston Post Road. The results of the study are currently being reviewed by Milford and Amherst.

Very little data exists on the water quality of the Souhegan's tributary streams. For this reason, it is necessary to rely on indirect indicators of water quality. These indirect indicators might include the abundance of various macroinvertebrate species in a stream, which vary in sensitivity to water pollution, or the type of fish species naturally found or stocked in a stream and their survival rates. Where little direct chemical or physical data exists, biological data must serve as the indicator of water quality trends.

The Merrimack River Atlantic Salmon restoration program is one indicator of the relatively high water quality of the Souhegan River and its major tributaries. According to the New Hampshire Fish and Game Department, 70-100,000 Atlantic Salmon frye have been released annually into the Souhegan River and its tributaries since 1984. Blood Brook and Stony Brook receive most of these Salmon fry. The Salmon fry are stocked in the spring, and typically stay in the river system for 2 years before swimming downstream in an attempt to reach the Atlantic Ocean. Studies conducted in the fall indicate that Salmon survival rates are high in the Souhegan River system. The Souhegan River system is considered to be one of the best Salmon nurseries in the state by federal and state fisheries biologists.

Point Sources of Pollution

There are five active NPDES discharges to the Souhegan River, one major and one minor municipal wastewater treatment facility, one major and two minor industrial dischargers.

The Greenville WWTF, constructed in 1975, is a secondary treatment plant with a design capacity of 0.25 MGD. Average discharges are 0.12 MGD during the months of May to December when the Pilgrim Foods plant is operating and 0.10 MGD from January to April. Historically, Pilgrim Foods treated their wastewater on-site and discharged directly to the Souhegan River; however, repeated violations of their NPDES permit resulted in converting to a wastewater pretreatment program and sending the treated waste to the Greenville WWTF.

With a design capacity of 2.15 MGD and an average daily discharge of 1.22 MGD, the Milford WWTF is classified as a major municipal discharge. Advanced secondary treatment places more stringent limitations on the effluent discharged from the facility. Milford is in the process of renewing its NPDES permit and anticipates stricter requirements for BOD, suspended solids and nitrification. In the future, the facility expects to be adding an alkalinity/pH adjuster to assist in achieving the nitrification and effluent pH limitations, and an effluent filtration system to meet the BOD standards.

The three industrial dischargers are Harcros Chemicals, Inc. in Merrimack, Hitchiner Manufacturing Co., Inc. in Milford and Souhegan Wood Products, Inc. in Wilton. All three businesses discharge noncontact cooling waters. Harcros Chemicals does not record or report flows. Souhegan Wood Products daily discharge averages 15,000 gpd and they are currently investigating heat exchange systems which could reduce this discharge even further. Hitchiner Manufacturing is the only major industrial discharge in the watershed with an average daily volume of

300,000 gpd to an unnamed tributary of the Souhegan River. Hitchiner is an excellent example of the achievements that can be made through conservation measures and advances in technology having reduced their discharge from 500,000 gpd in 1980 to 415,000 gpd in 1985 and 300,000 in 1993.

Nonpoint Pollution Sources

Nonpoint pollution sources (NPSs) within the watershed include landfills, hazardous waste sites, urban runoff, subsurface waste disposal, road salt, nutrients and pesticides. In 1982, the Water Supply and Pollution Control Division (WSPCD) conducted the statewide Inventory of Groundwater and Surface Water Potential Nonpoint Pollution Sources. The inventory identified waste disposal sites, salt piles and road salting practices, snow dumps, storm drains, excavations and areas with agricultural, urban and/or pesticide runoff in the NRPC region. The NH DES in conjunction with the regional planning agencies has been updating the information contained in the 1982 study. Based on the updated information from the NH DES, a total of 71 NPS have been identified in the watershed; eight salt storage piles - 7 covered, 1 uncovered in Greenville; 41 excavations or quarrying operations; three snow dumping sites; 17 storm drains; one wastewater treatment facility outfall; and one septage spreading site.

The NH DES WSPCD also maintains and distributes an "All Sites Listing". This master listing is comprised of several sub-lists: the Groundwater Hazard Inventory, the Hazardous Waste Site Inventory, the list of large underground storage tanks (USTs), the list of lined and unlined landfills and dump sites, and a list of junkyards. Several bureaus at NH DES compile each listing, and add or subtract sites on a continual basis. At this time it is difficult to determine which sites are located in the watershed. The NH DES WSPCD is currently adapting the Groundwater Hazard Inventory to enable the identification of each site on a map. When this information becomes available it should be incorporated into this study. The information presented below on NPS pollution within the watershed for each community has been obtained from the 1982 study, components of the all sites listing, the updated nonpoint source information for each community and a review of the Waste Management Division files. The information from these inventories is depicted on Map III-3, Potential Waste Sites, which has been provided to each community. Because of a problem with scale, that map has not been reproduced in this study.

Merrimack

A 1987 hydrogeologic investigation of the Harcros Chemicals site, formerly New England Chemical, conducted by Dubois and King, Inc., found groundwater contamination from more than one source in more than one location. The groundwater on the site contains significant amounts of volatile organic compounds (VOCs) most notably chlorinated ethanes and ethanes, three benzene compounds and two ketone compounds from at least four different sources of chemical compounds on the site. Chemical distribution operations have been carried out on the site since 1953. Harcros is currently conducting a Phase II site investigation and developing a remedial action plan to deal with the contamination. Merrimack has experienced significant growth in residential development within the watershed during the past 20 years. Potential NPSs from residential development includes effluent from failing or failed septic systems, and fertilizers and pesticides from lawns. Urban residential development is an increasing NPS because of fertilizers and pesticides applied to lawns.

Amherst

Two golf courses, the Amherst Country Club and Ponemah Greens, are located adjacent to the Souhegan River east and west of NH Route 122 and a third golf course, Souhegan Woods, is located just north of the River on the Merrimack border. Potential NPSs include nutrients from fertilizers and pesticides. Improper applications of fertilizers and pesticides can lead to increased concentrations in runoff, surface waters and groundwater. Excess nutrients in surface waters can result in an increase in growth of aquatic plants and algal blooms. Pesticide

contamination is a serious nationwide problem which has resulted in acute fish kills through entire river systems and long term mutagenic impacts to indigenous biota. Tuckahoe Turf Farms, another NPS of fertilizers and pesticides, has ceased operations in the region. There is currently a proposal before the Planning Board to develop a soccer complex near the River, another potential source of pesticides and nutrients. In addition, there exist some serious bank erosion problems along the Amherst stretch of the River. While a certain amount of the erosion is natural, the majority of the problems have been caused by a loss of shoreline vegetation resulting from insensitive land use practices.

The Groundwater Hazard Inventory lists several sites in Amherst. Many of these sites are found outside of the watershed in the Columbia Drive-Manhattan Park area, south of Route 101A. Of the remaining sites, the majority are underground injection controls (UICs), which are discharges of benign wastewater not requiring a groundwater discharge permit. The inventory also lists an abandoned dump off of Dodge Road, which is just to the northeast of the Amherst Common.

Milford

Milford has a number of potential NPSs. Improper applications of fertilizers and pesticides from agricultural operations, turf farms, parks and cemeteries within the watershed can lead to increased concentrations in runoff, surface water and groundwater. While Milford has a significant number of agricultural land uses, agricultural operations have declined and Tuckahoe Turf Farms is no longer operating in the region. The old Town landfill is located near the River south of North River Road and is the site of the existing transfer station. The landfill, which was closed in 1980, is unlined. Leachate from the landfill is a potential NPS to the River.

There are two National Priority List Superfund sites in Milford, the Savage Well and Fletcher Paint. In 1983 volatile organic compound (VOC) levels which exceeded drinking water standards were discovered in the Savage Well and the well was shut down. Subsequent investigations traced the potential source of the contamination and four manufacturing plants surrounding the well were identified as the potentially responsible parties (PRPs). In 1987, the PRPs agreed to conduct the remedial investigation and feasibility study of the site. The EPA held a public information meeting on the proposed plan for the site in July of 1991. Site remediation includes groundwater extraction at five locations and treatment to remove contamination from the ground water. Negotiations are in progress with the PRPs to implement the remedial design work necessary for clean-up of the site. The Fletcher Paint site consists of three areas: the Paint Works Plant on Elm Street, a storage facility on Mill Street and a drainage ditch which runs from the Mill Street facility through the Paint Works to the Souhegan River. In 1984, the Keyes municipal well was taken out of service because of VOCs and an investigation was begun to determine the source of the contamination. In 1985, EPA found VOCs, PCBs and heavy metals in the soil around the Paint Works and in Souhegan River sediments. In 1988, the EPA removed 863 drums from the site. In 1991, EPA's contractor began the remedial investigation of the site and the field work was completed in early 1992. Higher than expected levels of PCBs and paint waste were detected in the subsurface. Phase II studies called for additional monitoring wells and ground water, soil and sediment sampling which were conducted in the spring of 1993. Cleanup of the contaminated soils on the site has already begun.

The Grugnale Waste Disposal site in Milford is another significant NPS in the watershed. The Grugnale site was used for many years as a hazardous waste dumping ground and is a candidate for clean-up under the Superfund program. The 15 acre site is bordered on the north by Hartshorn Brook and is only 2,500 feet north of the Souhegan River. According to the Final Summary Report, Expanded Site Inspection, Grugnale Waste Disposal Site, Milford, New Hampshire, prepared by the NUS Corporation under the direction of the US EPA. and released in 1989, approximately 200 to 1,500 barrels of chemical waste were allegedly crushed and buried on the site in the 1970's. The barrels were thought to contain toluene, benzene and trichlorethylene and also lubricating oils, alkaline paint thinners, wood stains, resin filler and liquid shellac.

The expanded site inspection was initiated in October 1987 to evaluate the site's potential as a contributor of volatile organic compound (VOC) contamination to the Keyes municipal well in Milford, located one mile southeast of the site. In order to assess possible surface and groundwater contamination, 35 samples were collected in the area of the site in December of 1987. Eleven monitoring wells were also installed in order to provide hydrogeological information and evaluate groundwater quality and the extent of contamination. No significant organic contamination was found in the waters of Hartshorn Brook, though sediment samples there and elsewhere on the site did detect organic contaminants such as chloromethane, 4,4-DDT and PCBs. VOCs were detected in several of the monitoring wells but not in the neighboring residential wells. As the direction of groundwater flow on the site is to the south, the results of the testing indicate that the Grugnale Waste Disposal Site may be a contributor of contamination to the Keyes municipal well. The situation at the Grugnale Waste Disposal Site should be closely monitored.

The Groundwater Hazard Inventory contains many sites in Milford, several of which are manufacturing facilities associated with the contamination of the Keyes and Savage municipal wells. These include Hitchiner Manufacturing and Fletcher Paint Works, both located on Elm Street. Gasoline stations which have had leaking underground storage tanks are also included in the inventory. According to the Milford Fire Department, a spill of a petroleum product occurred at Draper Fuel on Amherst Street several years ago. The direction of groundwater flow in this vicinity is towards the Souhegan River. Draper Fuel has recently updated their facility and made improvements in their fuel handling and storage operations. Of the towns in the Souhegan River watershed, Milford contains the greatest number of groundwater hazard inventory sites, hazardous waste sites, underground storage tanks and RCRA facilities.

Urban runoff is also an NPS pollution within the watershed in Milford, particularly along the NH 101 and 101A corridors and in the downtown. Runoff from urban areas can carry with it gas, oil, road salt, sediments, anti-freeze, heavy metals and anything else that may be deposited on roads and parking areas. Snow is dumped adjacent to the River in two downtown locations. The snow can contain de-icing chemicals, sediments and other pollutants.

Wilton

As with Milford, there are a number NPSs in Wilton. The Town landfill is located adjacent to the Souhegan River off of NH Route 101. The unlined landfill is in the process of being closed. Monitoring wells have been installed, samples are taken on a regular basis, and a preliminary closure design has been submitted to the DES. Leachate from the landfill is a potential NPS to the River. Cyanide was allegedly buried on the Abbott Memorial site in downtown Wilton; however, the presence of overhead wires, the mill raceway and an iron railing interfered with the magnetic survey for the detection of underground storage drums. Water from two surface stations and three well stations was tested for the presence of cyanide, and cyanate and ammonia, potential breakdown products of cyanide. Free cyanide was detected in the groundwater samples but not in the surface water samples. Since the original investigation, monitoring has shown a continued decrease in the levels of cyanide, cyanate and ammonia. The consultants concluded that since the area is served by municipal water, the cyanide in the groundwater does not pose a significant health threat.

In addition, the Groundwater Hazard Inventory reports five sites in Wilton exclusive of those discussed above. The list indicates the presence of an old dump off of Dale Street, a permitted septage land application at Davidson Septic tank on Russell Hill Road, a leaking underground storage tank at the former Draper Fuel site on Souhegan Street, a hazardous waste project at Label Art located at One Riverside Way and an underground injection control for PV-EPVA, Inc., on NH Route 31.

Urban runoff is also a potential NPS threat in Wilton. The Wilton downtown directly abuts the River. Runoff from the buildings, roads and parking areas carries with it gas, oil, road salt, sediments, anti-freeze, heavy metals

and anything else that may be deposited on roads and parking areas. In addition, snow is dumped in two locations downtown directly adjacent to the River. The snow can contain de-icing chemicals, sediments and other pollutants.

Greenville

The Groundwater Hazard Inventory indicates three sites within the watershed in Greenville, an old dump off of Mason Road, and a spray irrigation project and an unlined wastewater lagoon at the Pilgrim Foods plant at 98 Cutter Mill Road. In addition, urban runoff from the Town center area poses a NPS threat to the River. The potential contents of urban runoff have been discussed in the previous sections.

Greenfield

The Groundwater Hazard Inventory indicates three sites in Greenfield that may be within the watershed. East Coast Steel, located off of Route 31, is listed as having had a spill or release of oil. The Mitchell Property building #2 site on Route 31 had a leaking underground storage tank. There is also an old dump site found off of Route 31.

Lyndeborough

The Groundwater Hazard Inventory lists a leaking underground storage tank at the town garage. This situation may have been remediated since the time the listing was generated.

Mont Vernon

The Groundwater Hazard Inventory indicates one site in Mont Vernon, an old dump site located near the intersection of Weston Hill Road and Mason Road.

Temple

The Groundwater Hazard Inventory lists three sites in Temple, two old dumps located near the intersection of Old Brown Road and Hill Road, and an oil spill or release at the Temple Public Library. This situation may have been remediated since the time the listing was generated.

New Ipswich

There are no hazardous waste sites or landfills located within the watershed in New Ipswich; however, the Groundwater Hazard Inventory indicates three sites. The three sites include: one LUST each at Ron's Citgo on Route 124 and the Village Mobil on Turnpike Road, and an oil spill or release at the Boyle Property on Page Hill Road. The spills and leaking underground storage tanks may have been remediated since the listing was generated.

Ashby and Ashburnham, Massachusetts

Discussions with the Massachusetts Department of Environmental Protection revealed that there are no documented waste sites in the watershed. NPSs within these communities would be similar to those found in other rural communities and discussed above.

Road Salt

One NPS pollution problem throughout the study corridor is road salt. Salting roads creates the potential for sodium and chloride contamination of surface water and groundwater. High levels of sodium and chloride in the drinking water supply can pose serious health threats to pregnant women, infants and people with heart, kidney or

liver diseases, hypertension and other metabolic disorders. High salt concentrations can also cause problems for animals and plants, kill trees and corrode metals and concretes. Increased concern for water quality has led to reductions in salt applications particularly in areas impacting public surface water and groundwater supplies and areas with concentrations of individual wells. Communities can protect water quality and save money by minimizing their use of road salt. One major road salt problem facing the River is its proximity to state highways and state maintained roads, primarily NH Routes 101, 101A, 31 and 123. Existing State Department of Transportation policy is to salt all state maintained roads in the winter.

Subsurface Waste Disposal

Subsurface disposal of wastes is another potential NPS throughout the watershed. Subsurface disposal of wastes is a lesser NPS in the communities that are serviced by municipal sewer systems. The Milford Wastewater Treatment Plant service area includes 1,050 acres of residential, commercial and industrial land in Milford, with 2,325 hook-ups as of February, 1994, according to the Milford WWTP superintendent. Approximately 50 percent of Milford's population is served by the municipal sewer system. The central portion of Wilton is sewered with the wastewater treated at the Milford WWTP. Approximately 30-40 percent of the population of Wilton is located within the sewer service area. The central portion of Greenville, north of Pleasant Street and west of NH Route 31, is also sewered, with 300 hookups as of February, 1994, according to the Greenville Department of Public Works. Approximately one-half of the Souhegan River watershed area in Merrimack is served by the municipal sewer system. This includes the eastern portion of the watershed area to the confluence with the Merrimack River and the areas north and south of the large bend in the river northwest of Horseshoe Pond. The area west of Turkey Hill Road to the Amherst border relies on on-site septic systems.

While portions of Merrimack, Milford, Wilton and Greenville are served by municipal sewer systems, the majority of the watershed relies on subsurface waste disposal. Nutrient rich effluent from failed or failing septic systems can drain into the River and its tributaries causing bacterial contamination and creating optimum conditions for algal blooms and other aquatic plant growth. The rate of septic system failure should be examined in all of the unsewered areas of the watershed to determine if a problem currently exists and to assess the potential for future problems.

Current State regulations require septic tanks and leachfields to be setback a minimum of 75 feet from surface waters, wetlands and open drainage areas. Communities have the authority to adopt regulations stricter than State standards. Increased setbacks and vegetative buffer strips would increase filtration of the effluent before it reaches the water body. Amherst, Wilton and New Ipswich require septic system setbacks greater than the State minimum. Amherst and New Ipswich have a standard septic system setback of 100 feet from lakes, ponds, rivers and streams. Wilton's Zoning Ordinance establishes a sliding scale for septic system setbacks (125, 100 and 75 feet) based on the characteristics of the receiving soil. The New Hampshire Supreme Court in the 1979 case Gillespie v. Freedom upheld a minimum septic tank and leachfield setback greater than the State standard.

Erosion and Sedimentation

Another potential NPS is soil erosion and sedimentation. Soil is eroded by wind and water when exposed to the elements through agricultural and silvicultural activities and through construction activities during land conversion. A portion of these eroded soil particles are transported by water into rivers streams, lakes and wetlands. Sediment is the largest nonpoint source of pollution in the United States. Since portions of the study corridor have experienced rapid growth during the last decade, this discussion will focus on development and construction activities.

During land conversions, much, if not all, of the protective vegetative cover is stripped from the site resulting in an increase in the velocity and volume of surface runoff. This increase results in a corresponding increase in the

capacity of the runoff to transport soil particles. Turbidity and sedimentation are the two major surface water problems associated with soil erosion. Increased turbidity in streams, generally evidenced by a decrease in clarity, can prevent sunlight from penetrating to lower water levels inhibiting photosynthesis and decreasing available oxygen levels. The reduced levels of oxygen place additional stress on fish species and other aquatic organisms, while suspended soil particles themselves can damage sensitive gills. Once the particles settle out of the water, accumulated sediments can cover fish spawning habitats and smother important food supplies such as macroinvertebrates.

There are a number of sites along the Souhegan River, and probably elsewhere in the watershed, with erosion problems. While a certain amount of erosion is natural, in most instances along the River the erosion is caused by changes inflow and the activities taking place along the shoreline. Activities which remove the vegetation to the top of the bank disrupt the fragile balance provided by the root systems of the trees, bushes and grasses. Specific problem land uses along the Souhegan include recreation fields and golf courses, turf farms and other agricultural uses, and residential development. The problems caused by these activities could be minimized by simply maintaining a vegetative strip along the top of the riverbank. The vegetative strip would protect water quality by stabilizing the soil and by filtering out sediments and other pollutants from stormwater runoff. In addition, by stabilizing the riverbank with a vegetative strip the landowner would eliminate the loss of land from erosion.

A number of methods exist for controlling soil erosion and sedimentation ranging from simply retaining as much of the natural vegetative cover as possible to constructing drainage systems to manage stormwater runoff. Requirements for erosion and sedimentation control vary with each community. Information on soils can be useful in determining the erodibility of a soil and the extent of erosion control needed. The Merrimack, Amherst, Milford, Lyndeborough, Greenfield and Wilton subdivision and site plan review regulations and the Temple, New Ipswich, Ashby and Ashburnham subdivision regulations require that soil information be provided on all development plans. Greenville and Mont Vernon regulations do not require the provision of soil information. In addition, the subdivision and site plan review regulations for the towns of Merrimack, Milford, Wilton, Lyndeborough, Greenfield, Temple, New Ipswich, Ashby, and Ashburnham specifically require stormwater management and erosion and sedimentation control plans as part of the development proposal while Amherst, Greenville and Mont Vernon do not.

The State of New Hampshire Water Supply and Pollution Control Division (WSPCD) regulates land disturbing activities under RSA 485-A:17 Terrain Alteration. Any activity which will disturb a contiguous land area of 100,000 square feet or more must submit a stormwater and erosion and sedimentation control plan and obtain a permit from the WSPCD prior to undertaking any activity on the site. The State Comprehensive Shoreland Protection Act, RSA 483-B, further requires that all activities within the protected shoreland (250 feet measured from the ordinary high water mark) of any fourth order or higher river that will disturb a contiguous land area of 50,000 square feet or greater obtain an alteration of terrain permit from the WSPCD. This applies to the Souhegan River from its convergence of the South and West Branches in New Ipswich to its confluence with the Merrimack River.

Effective stormwater management and erosion and sedimentation control is key to maintaining and improving water quality. It is critical that local development plans provide adequate control measures to minimize negative impacts on water quality.

Underground Storage Tanks

Underground storage tanks (USTs) are another potential NPS posing a substantial threat to both ground and surface waters. Leaks in USTs are difficult to detect and can go unnoticed for long periods of time while causing extensive contamination of water resources. A small amount of a petroleum based product can contaminate thousands of gallons of water. The rules developed for controlling nonresidential underground storage and

handling of petroleum liquids, New Hampshire Code of Administrative Rules Part Ws 411 Control of Nonresidential Underground Storage and Handling of Oil and Petroleum Liquids, explicitly prohibit the discharge or disposal of oil to the surface waters or the groundwaters of the State. UST facilities with a cumulative storage capacity of 1,100 gallons or more are required to register and obtain a permit from the DES-WSPCD. The DES-WSPCD maintains an updated listing of all USTs with capacities above the 1,100 gallon threshold. While the number of USTs in the watershed is too numerous to list here, the communities may wish to check the inventory and undertake an assessment of the condition of USTs within their community. The Groundwater Hazard Inventory includes a listing of identified leaking underground storage tanks. This listing is a valuable resource for communities wishing to identify risks to their surface and groundwater resources.

Tanks with a volume less than 1,100 gallons, oil-transmission and oil production facilities, residential fuel oil tanks for on-site consumption, and tanks for the storage of non-petroleum products are exempt from State regulations at this time. In addition, many tanks currently covered by Ws 411 may still not be registered with the WSPCD. There may also be abandoned tanks within the study corridor that pose potential threats to the area's surface and groundwater resources. To reduce the potential impact of USTs on surface and groundwater, many communities have conducted underground storage tank inventories to locate existing and abandoned USTs and to determine their contents. Additionally, owners of abandoned tanks are provided with information and assisted with proper closure of the tank.

Hazardous and Toxic Wastes

The use, generation or storage of hazardous or toxic chemicals presents another threat to water resources. Facilities that treat, store or dispose (TSD) of hazardous wastes are regulated by the Federal Resource Conservation and Recovery Act (RCRA). The RCRA program addresses proper management of hazardous wastes and requires all TSD facilities to obtain an operating permit. The RCRA program regulates facilities that generate 1,000 kg or more of hazardous waste per month. The DES WSPCD Groundwater Protection Bureau maintains an up-to-date list of RCRA facilities. The list indicates numerous RCRA facilities in the Souhegan River watershed, especially in Amherst and Milford. Since the list changes often due to businesses opening and closing, the watershed towns may want to obtain copies of the list to maintain updated records of those facilities.

The State of New Hampshire, Hazardous Waste Rules, 1988, regulates all generators of hazardous waste in two classifications: small generators - less than 100 kg per month; and large quantity generators - greater than 100 kg per month. Therefore, the State list of regulated facilities is much more extensive than the Federal list. The State list is updated monthly and a copy of the printout is on file for public review with the DES Waste Management Division, Bureau of Hazardous Waste.

The New Hampshire Hazardous Waste Site Inventory lists all known hazardous waste sites in the state by community. There are several classifications of hazardous waste sites in this listing. These include CERCLA (Superfund) and CERCLIS (Superfund candidate) sites, underground injection control sites, unlined wastewater lagoons, unlined landfills and other hazardous waste sites either monitored or regulated by the Groundwater Protection Bureau or the Waste Management Bureau of NH DES. Table III-3 lists those sites potentially located within the watershed that appear on the February, 1994 Hazardous Waste Site Inventory Listing.

TABLE III-3

SOUHEGAN RIVER WATERSHED

HAZARDOUS WASTE SITES

City/Town	Site Name	Site Address	Project Type
Amherst	Kamanilcki	Williamsburg Dr.	HAZWSTE/GP
Amherst	Moore Property	117 Rt. 101A	UIC
Merrimack	Harcros Chemical	441 DW Highway	HAZWSTE/GP
Wilton	EJ Abbott Mem.	Main Street	HAZWSTE/WM
Wilton	Label Art	One Riverside Way	HAZWSTE/GP
Milford	Grugnale Site	405 Jennison Road	HAZWSTE/WM
Milford	Hitchiner Mfg.	Elm Street	CERCLA
Milford	Hendrix Wire & Cable	Old Wilton Road	UIC
Milford	O.K. Tool Company	Elm Street	HAZ/NON-GW
Milford	Transformer Disp.	Route 31	HAZ/NON-GW
Milford	Fletchers Paint	39 Elm Street	CERCLA
Milford	Fletchers Paint	Mill Street	CERCLA
Milford	Permattach Diamond Tool Co.	67 Elm Street	HAZ/NON-GW
Milford	Aegis Inc.	Elm street	HAZ/NON-GW
Milford	Hitchiner Landfill	Perry Road	HAZWSTE/WM
Milford	Milford Motors	Mont Vernon Road	HAZ/NON-GW
Milford	New England Steel	Old Wilton Road	HAZ/NON-GW
Milford	A.M.P. Corp.	Elm & Westchester	HAZWSTE/GP
Milford	Savage Well	Off Route 101	CERCLA
Milford	Keyes Well	River Road	CERCLA
Milford	Milford Landfill	River Road	LAND/UNLN
Milford	Watts Regulator	49 Powers Street	HAZWSTE/GP
Milford	Fletcher Outfall	Elm Street	SPILL/RLS
Milford	Gar-Doc Inc.	Powers Street	HAZWSTE/GP
Milford	Permattach Diamond	127 Elm Street	HAZ/NON-GW
Milford	Longely II Apts	Amherst Street	HAZ/NON-GW

Water Flow

Previous sections have focused on the issues of water quality and the many competing natural and manmade uses and users of water within the Souhegan River watershed. Water in the Souhegan River system is finite. Despite the fact that the River and its tributaries are highly regulated for flood control, water levels fluctuate greatly throughout the year. Heavy snow and rain may cause an excess in one year while drought conditions may be experienced in the next. In addition, one large withdrawal or the cumulative impact of a number of smaller withdrawals has the potential to create serious problems related to the quantity and quality of water available for other users. The challenge is to balance the water needs of the many competing uses of the river for fish and wildlife habitat, waste assimilation, hydropower, water supply and recreation to ensure the continuation of the multiple use capabilities of the river. The most important factor is maintaining water flows sufficient to sustain these multiple uses, a concept called minimum instream flow.

Souhegan River flows are measured in only one location, just above Wildcat Falls in Merrimack. The station operated as a full station until 1976 when it was converted to a partial station which is used only during periods of extreme weather, to estimate flooding conditions or drought severity. The monthly average flows for the Souhegan River as reported in the USGS publication, Statistical Analysis of Stream Gauging Data, 1981, are contained in Table III-4. Flows range from a high of 818 cfs in April to a low of 39 in September.

TABLE III-4
AVERAGE MONTHLY FLOWS
SOUHEGAN RIVER AT MERRIMACK, NH
1967-1976

Month	Mean Flow (cfs)
October	45
November	202
December	274
January	218
February	284
March	553
April	818
May	392
June	219
July	110
August	60
September	39

Source: USGS/S.L. Dingman and G.K. Capsis, 1981

The 7Q10 flow, the lowest seven day sustained flow which occurs once in ten years, for the Souhegan River is 12.8 cfs. The 7Q10 flow rate is used as the minimum flow for waste assimilation in calculating waste loads. The waste load allocation study conducted by the NH DES determined that if the Milford WWTF discharged at its design capacity, 2.15 MGD, under 7Q10 flow conditions Class B water quality standards for dissolved oxygen could not be met; however, at the existing average daily flow of 1.22 MGD the standard would be met. This indicates that any further discharges to or withdrawals from the Souhegan River would have to be carefully considered and balanced with the existing demands on the river resource.

The fluctuation in flows may create problems between competing uses. Two uses that may coexist comfortably during periods of high water, such as waste assimilation and contact recreation, will not be compatible during low flows. Waste discharges could conceivably exceed their permit limitations and create serious water quality problems that would threaten health; reduce available water supplies; stress plant and animal species; and limit recreational use of the River. Optimum treatment of waste discharges can reduce adverse impacts on water quality during low flows.

The minimum flows required to sustain the diverse uses of a river have yet to be established. The NH DES Rivers Program and the Water Resources Division have been studying the issue of minimum instream flows. The New Hampshire Rivers Management and Protection Program, RSA 483, requires that minimum instream flows be established for all designated rivers. The results of the DES study have yet to be finalized and released for use.

Water Supply

Facilities which use 20,000 or more gallons of surface water or groundwater per day (gpd) are required to register with the NH DES Water Management Bureau (WMB) and to provide information on average and daily water demand. Once registered, the facility must report its monthly water use to the WMB. According

to WMB records for March 1994, there are sixteen registered surface water and groundwater withdrawals within the Souhegan River watershed.

Currently there are no surface water withdrawals for public water supplies from the Souhegan River; however, Pennichuck Water Works withdrew water from the river from 1965-1984 at a maximum rate of 10.8 cfs and maintains the right to withdraw water in the future. There are five municipal water supply wells in the watershed, one in Amherst, two in Milford and two in Wilton. Monadnock Spring Water in Wilton is the only commercial well in the watershed that markets a regional product. Monadnock Spring Water only recently registered with the WMB and reports an average daily withdrawal of 28,000 gpd from its two wells. Hydrogeological studies of the Milford and Wilton wells indicate that the potential for induced recharge of the wells from the river is minimal.

Hitchiner Manufacturing in Milford is the only registered industrial groundwater withdrawal in the watershed. Average daily demand is reported at 360,000 gpd. The NH Fish and Game Department withdraws water from two on-site wells to operate the Milford Fish Hatchery. Average Daily use reported for 1993 was 1,402,000 gpd from well number four and 1,278,000 from well number one.

The primary uses of surface water in the Souhegan River watershed are irrigation and hydropower. Greenville is the only community in the watershed with a municipal surface water supply. The Greenville Water Works, owned and operated by the NH Water Resources Division, withdraws water from an impoundment on Richardson Brook. Average daily use for 1993 was reported as approximately 145,000 gpd.

Only three registered uses withdraw water directly form the Souhegan River for irrigation purposes. Two of the irrigation withdrawals in Amherst are registered to the Amherst Country Club and Souhegan Woods Golf Club. Amherst Country Club, an 18 hole course, withdraws water from the river from April to October. In 1993, they reported the following monthly withdrawals (in gallons): April-62,000, May-3,987,500, June-7,703,700, July-6,991,400, August-6,007,600, September-3,515,100 and October-1,490,600. Souhegan Woods also withdraws water from April to October. In 1992, they reported the following monthly withdrawals (in gallons): May-3,000,000, June-8,000,000, July-16,000,000, August-10,000,000, September-1,000,000 and October-1,536,000. Irrigation is considered a consumptive use of water. Consumptive uses are those which result in transpiration by plants, evaporation, or out of basin transfers; water withdrawn from the river is consumed and returned at a significantly reduced rate. The WRD recently received a registration for a withdrawal in Amherst to irrigate 60 acres of agricultural land along the Souhegan River.

There are five registered withdrawals for hydro facilities, two in Greenville, one in New Ipswich, one in Wilton and one in Milford. All five facilities are run-of-the-river; the water moves into the turbines and is almost immediately returned to the river. This is considered a nonconsumptive use since the water is returned to the source at the same rate as which it was withdrawn.

Temple Mountain in Temple utilizes water from a pond to make snow. Typically, Temple Mountain withdraws water from November to February. In 1992/1993 they reported monthly uses of (in gallons): November-504,000, December-31,401,000, January-34,352,000 and February-12,641,000. Quinn Brothers excavation in Wilton utilizes water from Stony Brook in processing sand and gravel from the site. Quinn Brothers generally operates from April to November or December. In 1993 they reported monthly withdrawals of (in gallons): April-4,800,000, May-9,600,000, June-7,200,000, July-10,008,000, August-10,560,000, September-10,008,000, October-9,120,000, November-10,560,000 and December-3,840,000.

The list of registered water users does not reflect the total picture of water supply in the Souhegan River watershed. Some facilities which withdraw 20,000 or more gallons per day have not yet registered with the

WMB. Also, numerous withdrawals probably exist that are not required to register because they use less than 20,000 gpd.

The pressures on the Souhegan River to support consumptive and nonconsumptive water uses will only increase in the future. The impact of water withdrawals on waste assimilation and in-stream uses could be significant. Balancing these competing uses is essential to the continuation of the Souhegan as a multiple use river.

HYDROPOWER

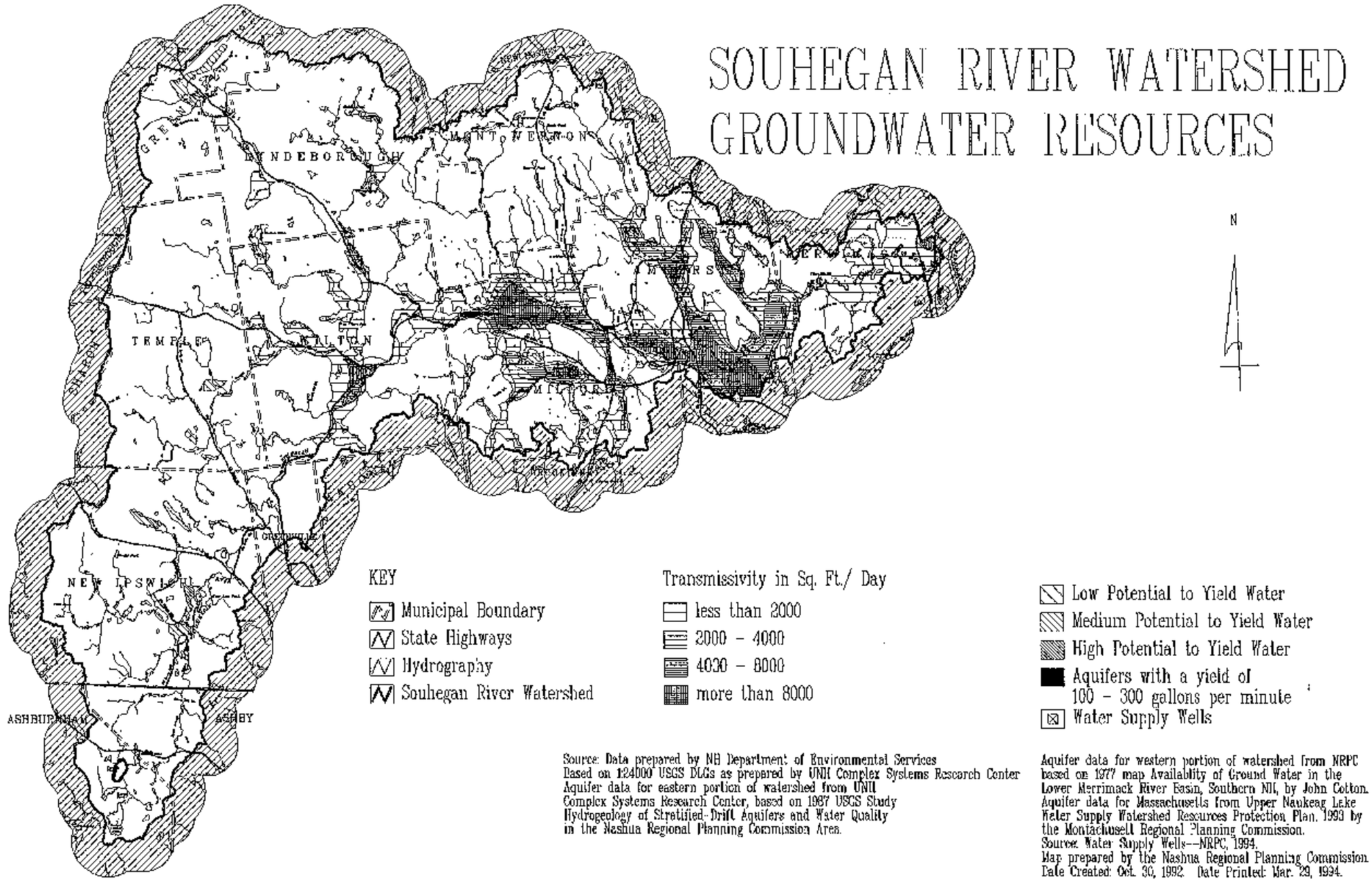
Water has been used throughout history to generate power. Many of the Country's cities are situated along rivers and streams where the water could be harnessed to run mills. The Souhegan River exemplifies this history as it first powered saw and grist mills, and later textile and other industrial mills. Today, many of those dams generate electricity. There are seven dams on the Souhegan River, one in New Ipswich, two in Greenville, two in Wilton, one in Milford and one in Merrimack. Five of the dams are operating hydro facilities, one is currently under construction and another is in the development stages.

All of the hydro dams on the Souhegan River are considered run-of-the-river facilities. Proceeding from west to east on the River, the dams include: Water Loom Falls dam in New Ipswich, Otis Falls and Chamberlain dams in Greenville, the Wilton Hydrosystems dam and Pine Valley dam in Wilton, the McLane dam in Milford and the Merrimack Village dam in Merrimack. The Water Loom Falls, Otis Falls and Chamberlain Falls dams are all operated by Chamberlain Falls Hydro. The Water Loom Falls dam, reconstructed in 1979, is 200 feet long with a vertical drop of 21 feet. The facility produces 100 kwh of power. The Otis Falls dam, 100 feet wide with a vertical drop of 21 feet, was reconstructed in 1980 and produces 150 kwh of power. The Chamberlain Falls Dam is 80 feet wide with a vertical drop of 27 feet and was reconstructed in 1982. The facility generates 150 kwh of power. It should be noted that there is only about 800 feet of river between the Otis and Chamberlain dams. The Pine Valley facility in Milford was reconstructed and came on-line in 1987. The facility can produce 500 kwh of power under optimum water conditions; however, water levels in the river curtail and even halt operations of the facility. The hydro facility at the McLane dam in Milford is currently under construction and is expected to be operational by 1994. Discussions are currently underway between the owner of the Merrimack Village dam and a hydro developer to develop a generating facility. All power generated by the hydro facilities on the Souhegan River is sold to Public Service Company of New Hampshire.

Dams have historically been a constant presence on the Souhegan River. The existing hydro facilities once powered the mills. The conversion of these facilities to the generation of power represents a responsible use of the River resource.

#500F-11

MAP III-1



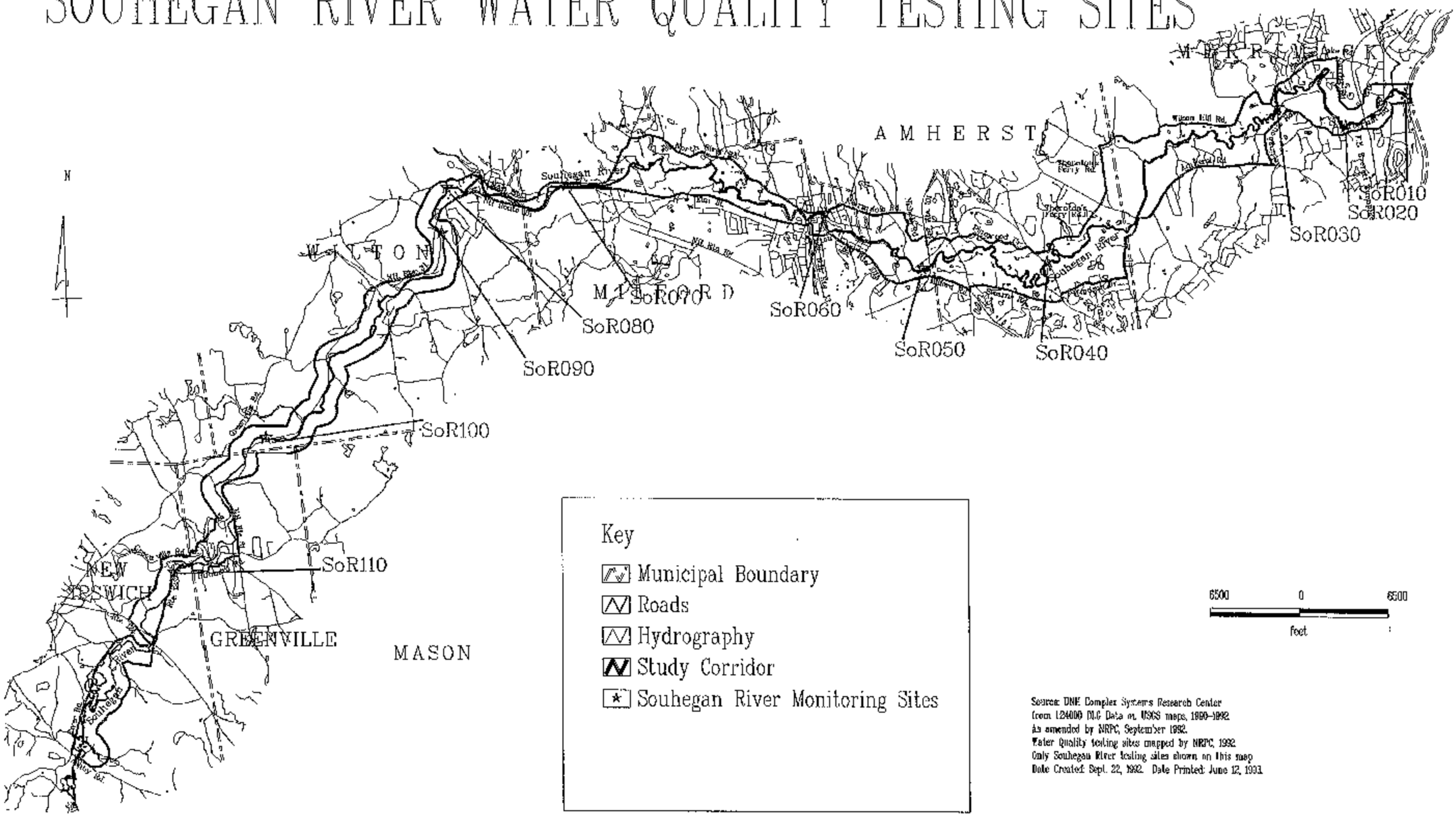
Source: Data prepared by NH Department of Environmental Services
Based on 124000 USGS DLGs as prepared by UNH Complex Systems Research Center
Aquifer data for eastern portion of watershed from UNH Complex Systems Research Center, based on 1987 USGS Study Hydrogeology of Stratified-Drift Aquifers and Water Quality in the Nashua Regional Planning Commission Area.

Aquifer data for western portion of watershed from NRPC based on 1977 map Availability of Ground Water in the Lower Merrimack River Basin, Southern NH, by John Cotton.
Aquifer data for Massachusetts from Upper Naukeag Lake Water Supply Watershed Resources Protection Plan, 1993 by the Montachusett Regional Planning Commission.
Source: Water Supply Wells--NRPC, 1994.
Map prepared by the Nashua Regional Planning Commission
Date Created: Oct. 30, 1992 Date Printed: Mar. 29, 1994.

#500F-3

MAP III-2

SOUHEGAN RIVER WATER QUALITY TESTING SITES



SECTION IV:

LAND USE

SECTION IV: LAND USE

Land use throughout the Souhegan River watershed influences the quantity and quality of surface water and ground water. Impervious areas such as parking lots or structures increase the volume of runoff. Expanded volumes result in increased velocity which in turn intensifies the erosive potential of the flow. Runoff from impervious areas carries with it road salt, oil, gasoline, anti-freeze, sediments, heavy metals and other pollutants that have an impact on water quality. Control of these impacts is best achieved at the local level through local zoning, subdivision and site plan review regulations, and enforcement of local, state and federal regulations.

Land use, road systems and the overall economy will have significant impacts on future development within the watershed and the condition of the Souhegan River. Land uses can change over time; however, it is highly unlikely that the existing uses of developed parcels within the watershed will change significantly in the near future. Changes are most likely to occur on those parcels currently in low intensity uses such as agriculture and vacant land or large industrial parcels that may be further subdivided and/or developed.

The economy and market demand can also have a notable impact on land use and development. A declining economy and decreased demand will slow the pace of development while a strong economy will have the opposite effect. In addition, land currently held for residential development, for example, may have a higher demand and command a higher price as commercial or industrial property.

Road systems transport people, goods and services to and from an area. To adequately serve the resident and transient populations of the watershed, the road network needs to contain major and minor roads. In addition to the road system, adequate parking at destination points in the watershed, such as employment centers, shopping centers and particularly recreation areas, is essential to meet the demands of users and to avoid conflict with surrounding residential and other uses. Therefore, a well developed road and parking network is essential to encourage use and to facilitate access to the River and the resources of the watershed.

This section examines existing land use and zoning regulations in each community, the existing road system and recreation within the watershed.

LAND USE

A diversity of land uses exist within the Souhegan River watershed. This examination of land use within the watershed is based on an interpretation by areas not individual parcels. For example, if an area is largely commercial with a few interspersed residential uses, the area would be coded commercial based on the dominant land use. This type of assessment provides information sufficient to evaluate large land areas like the Souhegan River watershed. Seven general land use categories have been identified for the watershed: low density residential, high density residential, commercial, industrial, open space/recreation, institutional and vacant. Generalized land use for the watershed is depicted on Map IV-1 while a summary of land use by community is presented in Table IV-1.

The majority of the land in the watershed is categorized as vacant, particularly in the western and northern reaches of the watershed. This is due in part to the physical constraints of the land, i.e. floodplains, steep slopes and wetlands as well as to the proximity of the communities to employment centers and the existing road network. Some of the land within this category may be actively managed for agriculture and forestry; however, since agricultural and forest lands can be converted relatively easily to other types of use, they are classified as vacant for future analysis of the watershed development potential.

The low density residential category includes residential uses on parcels greater than one acre in size. This is the second largest category of land use within the watershed accounting for approximately 18.8 percent, 20,595 acres, of the total area. Most of the low density residential development within the watershed is served by on-site septic systems. Much of the residential development in the more urban communities in the watershed, Merrimack, Amherst and Milford, is located in larger subdivisions which developed during the last 20 years, while development in the more rural areas of the watershed is primarily located along the existing road network. Because of the lack of municipal water and sewer service in the watershed, low density residential development will continue as the dominant form of residential development

TABLE IV-1
SOUHEGAN RIVER WATERSHED
GENERALIZED LAND USE

Community	*Low Density Res.*	*High Density Res.*	*Comm.*	*Indust.*	*Institu-tional*	*Open Space/ Rec.*	*Vacant*	*TOTAL*
Amherst	4,169	0	28	59	90	1,072	6,375	11,762
Ashburnham, MA	73	0	0	12	3	199	2,323	2,610
Ashby, MA	7	0	0	11	0	238	2,492	2,748
Brookline	56	0	0	0	0	0	193	249
Greenfield	192	0	4	8	0	1,154	3,246	4,604
Greenville	101	133	9	49	26	277	1,489	2,084
Lyndeborough	1,419	0	1	0	17	392	13,335	15,164
Mason	0	0	0	0	0	17	212	229
Merrimack	1,503	315	33	10	141	181	2,884	5,067
Milford	3,037	348	337	510	196	835	7,678	12,941
Mont Vernon	2,126	0	25	0	41	422	5,725	8,339
New Ipswich	2,395	0	207	0	99	548	11,317	14,566
Temple	1,540	0	0	0	10	2,466	9,431	13,447
Wilton	4,008	110	51	210	281	1,172	9,620	15,452
TOTAL:	*20,626*	*906*	*695*	*869*	*904*	*8,973*	*76,320*	*109,262*
% of Watershed	*18.9%*	*0.8%*	*0.6%*	*0.8%*	*0.8%*	*8.2%*	*69.9%*	*100.0%*

All figures in acres rounded to nearest acre.
Note: Open Space/Rec. includes public and private open space and recreation lands.
Source: Ashby/Ashburnham land use from Upper Naukeag Lake Water Supply Watershed Resources Protection Plan by Montachusett Planning Commission, April, 1993.
NH land use information generated by NRPC and SRPC, 1994.

High density residential development, parcels less than or equal to one acre, within the watershed is primarily located in the historic Town centers and areas currently served by public water and sewer systems. Approximately 0.8 of a percent, 906 acres, of the watershed falls into this category. Milford, Wilton and Greenville are the only communities with public water and sewer service areas covering significant portions of the watershed. Merrimack's water and sewer service in the watershed is limited to the area east of the F.E. Everett Turnpike which is largely industrial in nature. The densely developed areas in Milford, Wilton and Greenville are in close proximity to the Souhegan River. Future high density residential development within the watershed will be limited by the existing capacities of the Milford and Greenville wastewater treatment facilities and the extension of water and sewer services.

Commercial land uses represent approximately 0.6 of a percent, 695 acres, of the total watershed area. The bulk of the commercial uses are located along NH Route 101A in Amherst and Milford, NH Route 101 in Milford and Wilton, along Main Street in downtown Wilton, downtown Greenville and along NH Route 123 in New Ipswich. Commercial uses are very limited in the Mont Vernon, Lyndeborough, Greenfield and Temple portions of the watershed. Commercial uses are scattered throughout New Ipswich due in part to the Town's zoning. Future development of commercial uses is likely to continue along the major roads within the watershed as is reflected by the zoning.

Industrial land uses are also predominantly located along the major transportation routes in the watershed, the NH Route 101, 101A and 31 corridors and near the Everett Turnpike in Merrimack. These corridors are located in close proximity to the Souhegan River or major tributaries for most of their length. Historically, industrial uses were located along the river because of their need for power. Industries continue to locate in the river corridor because of the road system and will probably continue based on the zoning in the watershed. Industrial land uses represent about 0.8 of a percent, 869 acres, of the total watershed area.

The institutional use category includes such things as government buildings, schools, cemeteries, municipal facilities, churches, clubs and other organizations. The idea is to differentiate these types of uses from other types of publicly owned open space and recreation lands. Institutional uses represent 0.8 of a percent, 904 acres, of the total watershed area. Future development in this category is likely to be limited.

The open space and recreation category includes both public and private conservation and recreation uses. Overall, 8.2 percent of the watershed, 8,973 acres, is classified as open space and recreation. The largest single conservation area in the watershed is the Wapack National Wildlife Refuge owned by the US Fish and Wildlife Service. The Refuge, with approximately 1,670 acres of land in Greenfield, Temple and Lyndeborough, represents 18.6 percent of the open space/recreation land in the watershed. Other significant parcels of public land include: Miller State Park in Temple, 533 acres; a 460 acre tract in Temple and Wilton owned by the Society for the Protection of New Hampshire Forests (SPNHF); the Russell Abbot State Forest in Wilton, 443 acres; Lamson Farm in Mont Vernon, 331 acres; the Hitchner and Tucker Brook Town Forests in Milford, 208 and 258 acres respectively; Putnam Pond and Town Forest in Lyndeborough, 350 acres; and the recently acquired Taft Land in Greenville, 200 acres. Altogether, 78.5 percent of the open space/recreation land in the watershed is protected in public ownership. Of the remaining 21.5 percent, 508 acres are included in the Windblown Ski Touring Center, Temple Mountain and Mt. Watatic Ski areas; Timberdoodle and Skinny Kat shooting preserves in Temple, Wilton and New Ipswich encompass 775 acres; and four golf courses in Amherst cover an additional 330 acres. Thus, approximately 1,940 acres of land in private ownership could be converted from open space/recreation to a higher intensity use in the future.

EXISTING ZONING

Zoning is the principal tool available to municipalities for managing land use. Communities are granted the authority to zone by NH RSA 674:16 "for the purpose of promoting the health, safety or the general welfare of the community . . .". The power to zone includes the right to adopt innovative land use controls such as performance standards, environmental characteristics zoning and open space design. One stated purpose for zoning that applies to watershed management is "to assure proper use of natural resources . . ." (RSA 674:17). Therefore, the basis for protecting the Souhegan River watershed through the use of zoning is established in State statute as well as within the power of the localities.

Each of the twelve communities in the watershed has an adopted master plan, a zoning ordinance and subdivision regulations. Existing zoning for each community's portion of the watershed is depicted on Map IV-2 and a summary of zoning by community is presented in Table IV-2. In order to provide some level of comparability between the communities, particularly with regard to residential districts, zoning categories

were established as follows: very low density residential - minimum lot size 3 acres or greater; low density residential - minimum lot size 2 to 2.99 acres; medium density residential - minimum lot size 1 to 1.99 acres and high density residential minimum lot size less than 1 acre; office park; commercial; industrial; and historic.

Of the total watershed area, 92.6 percent is zoned for residential land uses, 2.9 percent for industrial, 1.1 percent for commercial, 0.6 percent historic and 0.1 percent for office park. With regard to the Souhegan River, the concern is not how much land is in a particular zone but where the zone is located relative to the Souhegan and its tributaries, the types of uses permitted within the zone and the presence or absence of municipal services. As you can see from Map IV-2, the majority of the commercial and industrial areas within the watershed are located in close proximity to the River or one of its major tributaries.

The information provided in this section is presented as a basic overview of the communities' regulations and the types of uses permitted within the watershed. More detailed information can be obtained by examining the regulations of the individual communities. The information presented below is based on the local regulations in effect as of Town Meeting 1994.

TABLE IV-2

SOUHEGAN RIVER WATERSHED

ZONING

Community	*Very Low Density Resid.*	*Low Density Resid.*	*Medium Density Resid.*	*High Density Resid.*	*Office Park*	*Comm.*	*Indust.*	*Historic*	*TOTAL*
Amherst	243	10,749	0	0	0	141	14	615	11,762
Ashburnham, MA	0	0	2,610	0	0	0	0	0	2,610
Ashby, MA	0	0	2,748	0	0	0	0	0	2,748
Brookline	0	0	249	0	0	0	0	0	249
Greenfield	4,270	0	0	0	0	0	334	0	4,604
Greenville	0	0	1,350	0	0	306	428	0	2,084
Lyndeborough	3,523	11,526	0	0	0	0	115	0	15,164
Mason	0	229	0	0	0	0	0	0	229
Merrimack	0	0	4,994	0	0	55	18	0	5,067
Milford	0	0	8,301	2,546	0	542	1,552	0	12,941
Mont Vernon	3,175	5,100	0	0	0	63	0	0	8,339
New Ipswich	0	14,281	285	0	0	0	0	0	14,566
Temple	13,349	125	0	0	0	0	0	0	13,447
Wilton	2,294	0	11,609	469	59	46	760	0	15,452
TOTALS:	*26,854*	*42,010*	*32,146*	*3,015*	*59*	*1,153*	*3,221*	*615*	*109,262*
% of Watershed	*24.6%*	*38.6%*	*29.4%*	*2.8%*	*0.1%*	*1.1%*	*2.9%*	*0.6%*	*100.0%*

All figures in acres rounded to nearest acre.
All zoning as of May 15, 1994.
Source: NRPC GIS, 1994.

Merrimack

The majority of the watershed area in Merrimack, all of the land west of the Everett Turnpike, is zoned for residential development. Zoning east of the Everett Turnpike is commercial and industrial. The uses permitted within each district include:

General or Limited Commercial (55 acres): limited commercial permits stores for the sale of retail goods or services; business and professional offices; specifically excludes banks, automotive uses of all kinds, hotels and motels; permitted by special exception restaurants, cafes, residential and accessory uses; general commercial permits stores for the sale of retail goods and services; business, professional and banking offices; research and development; restaurants and cafes; parking lots for transient motor vehicles; hotels and motels; and churches; permitted by special exception accessory uses, residential, public facilities, sale or storage of new or used cars, commercial recreation and entertainment, and gasoline and automobile service stations.

Industrial (18 acres): manufacturing industries; warehouse and wholesale uses; offices greater than 10,000 sq. ft.; public utilities; churches; gas stations; enclosed service and repair; sales service and repair of machinery and transportation equipment; freight and trucking terminals, offices and brokers; contractor yards; parking garages; animal hospitals and veterinary clinics; research and testing laboratories; fuel storage and distribution (bulk); printing establishments; contract cleaning establishments; industrial supply establishments; support uses to industrial district - restaurants, branch banks, offices, hotel/motel; and breweries and bottling facilities.

Residential (4,994 acres): residential uses; home occupations; and permitted by special exception churches and accessory dwelling units.

There is no minimum lot size for industrial developments; however, floor area ratios cannot exceed 0.4 for a one story building or 0.8 for a two story building and buildings must be set back a minimum of 100 feet from D.W. Highway. In addition, all developments in this district must be served by municipal water and sewer. Minimum lot size in the commercial districts is 20,000 sq. ft. with 125 feet of frontage. Floor area ratios are the same as the industrial district. Minimum lot size requirements in the residential district range from 40,000 to 100,000 square feet based on soil limitations and the presence of municipal water and sewer. Cluster development of one, two or four unit residential structures is allowed in all residential districts with a minimum parcel size of 15 acres and municipal water and sewer. In addition, the Town has adopted a number of regulations to protect its natural resources, such as the floodplain conservation district, the wetland conservation district, the aquifer conservation district, and shoreland protection.

Amherst

Amherst's portion of the watershed is predominantly zoned for residential development. Two small general office districts are located along NH Routes 101 and 101A while one area along NH 101A is zoned for commercial uses and one area is zoned for industrial uses. In addition, the Town center area is included in an historic district. Uses permitted in each district include:

Rural Residential (10,749 acres): single-family and accessory buildings; planned residential development; farm, agricultural or nursery uses and roadside stands for the sale of products; home occupations; open space plan; amateur, nonprofit sports and recreation uses; and family daycare uses; permitted by special exception accessory dwelling units, religious purposes, private schools, hospitals, clinics, nursing homes and other similar uses, professional offices, kennels and elderly housing developments.

Northern Rural (243 acres): single-family and accessory buildings; planned residential development; farm, agricultural or nursery uses and roadside stands for the sale of products; home occupations; open space plan; amateur, nonprofit sports and recreation uses; and family day care; permitted by special exception accessory dwelling units, religious purposes, private schools, hospitals, clinics, nursing homes and other similar uses, professional offices, funeral homes sawmills and kennels.

Commercial (141 acres): retail establishments; hotels and motels; public utility buildings, structures or facilities; home occupations; planned residential developments; mixed use developments; amateur, nonprofit sports and recreation uses; and family daycare uses; permitted by special exception outside recreation establishments excluding outdoor theaters, outside storage of equipment and materials excluding junk yards, religious uses, private schools hospitals, nursing homes and other similar uses, accessory dwelling units and kennels.

Industrial (14 acres): light manufacturing; assembly; metal working; equipment sales and service; creamery, bakery and soft drink bottling plants; distribution plants, service industries and parcel delivery; laboratories; corporate and business offices, and professional offices; wholesale business and storage; storage yards excluding junk yards; coffee or sandwich shops excluding fast service types; veterinary clinic, interior recreational establishments; home occupations; public utility buildings, structures or facilities; affordable housing; and amateur, nonprofit sports and recreation uses; permitted by special exception kennels.

General Office (59 acres): professional offices; general offices for the handling of administrative functions; mixed use development; amateur, nonprofit sports and recreation uses.

Minimum lot size in the rural residential district is two acres with 200 ft. of frontage for regular lots and 35 ft. of frontage for reduced frontage lots (back lots). Minimum lot size in the northern rural district is five acres with 300 feet of frontage on a publicly maintained road and 35 feet of frontage for reduced frontage lots. Open space plans require maintaining the overall density, two acres/unit, but allow for the development of residential units on 40,000 sq. ft. lots to encourage the maintenance of open space. Minimum parcel size for open space plans is ten acres in the rural residential district and 25 acres in the northern rural district. The planned residential development standards allow for the development of different housing types at densities greater than required by the underlying zone. Density is determined by dividing the overall acreage by two in the rural residential and commercial districts, and by 3.75 or 4.25 based on soil limitations in the northern rural district and then multiplying that number by a factor which is based on the soil classification. Single-family attached and detached structures, and multi-unit structures with three to six units are permitted in planned residential developments. Minimum tract size for a planned residential development is 20 acres in the rural residential and commercial districts, and 25 acres in the northern rural district.

Commercial district minimum lot size is one acre with 200 feet of frontage on a publicly maintained road. Setbacks are 50 or 100 feet from NH 101A depending on the location of parking and 50 feet from all other roads in the commercial district. The floor area ratio shall be a maximum of 25 percent and a minimum of 30 percent of the area of any lot shall remain as landscaped open space. The industrial district minimum lot size is one acre with 200 feet of frontage on the principal route of access with building setbacks of 50 or 100 feet depending on the location of the parking. The floor area ratio shall be a maximum of 40 percent and a minimum of 30 percent of the area of any lot shall remain as landscaped open space. The general office district requires a minimum lot size of one acre except for residential uses which require two acres with 200 feet of frontage on the principal route of access. Again, there is the 50 or 100 foot setback requirement depending on the location of parking. The floor area ratio shall be a maximum of 20 percent with 30 percent required for landscaped open space.

In addition, the Town has adopted a number of regulations to protect its natural resources such as a floodplain conservation district, a wetland conservation district and an aquifer protection district. The watershed protection district, essentially a shoreline protection district, includes all lands within 100 feet of a water body and a perennial or intermittent stream. Septic systems and buildings are prohibited within the district. Uses permitted within the district include miscellaneous trimming, pruning and thinning according to good forestry practices; tree farming, timbering and forestry according to practices approved by the County forester; wildlife refuges; wharves, boat houses, footbridges or similar structures normally associated with use in or near water; and amateur, nonprofit sports and recreation uses.

Milford

Land within the Milford portion of the watershed is chiefly zoned residential with sixteen percent of the area zoned for commercial and industrial uses. The industrial and commercial lands are predominantly located along NH Routes 101A and 13, south of and directly adjacent to the Souhegan River. The uses permitted within each district include:

Commercial (471 acres): retail and wholesale businesses; restaurants; filling stations, garages and parking lots; professional offices and banks; hospitals and/or medical facilities; schools, colleges, business or trade schools; hotels, motels and inns; churches; theaters and bowling establishments; laundries and dry cleaning; newspaper and job printing; funeral homes; the uses permitted in residence "A" and "B" districts; and elderly housing; permitted by special exception dumps and junk yards, mobile homes and communication towers.

Limited Commercial (71 acres): professional offices; hospitals and/or medical facilities; schools, colleges, business or trade schools; bed and breakfasts; churches; funeral homes; uses permitted in Residence "A" and "B"; elderly housing; permitted by special exception dumps and junk yards, mobile homes, retail and wholesale businesses, restaurants, filling stations and garages, and banks.

Industrial (975 acres) harvesting and processing of natural resources; and light industrial and manufacturing.

Integrated Commercial-Industrial (577 acres): wholesale businesses; retail businesses; restaurants; professional offices and banks; hotels, motels and inns; day care facilities; public utility uses; light industrial and manufacturing; distribution and mailing facilities; research and development laboratories; automotive service and repair; harvesting of natural resources; permitted by special exception schools.

Residential District (10,847 acres): "A" district (2,253 acres): single-family residences and accessory buildings; permitted by special exception home occupations, recreation and community center buildings, kindergartens and day nurseries, churches, and public utilities; "B" district (293 acres): multi-family with municipal water and sewer; single-family and two-family dwellings; permitted by special exception hospitals, schools and funeral homes; "R" district (8,301 acres): uses permitted in "A" district; hospitals; schools; farm, agriculture or nursery; mobile homes; harvesting of natural resources; and recreational uses; permitted by special exception two-family residences and communication towers.

Minimum lot size and frontage requirements in the commercial, limited commercial and industrial districts are 20,000 sq. ft./150 ft. of frontage with municipal water and sewer and 60,000 sq. ft./225 ft. frontage without water and sewer. Lot size and frontage requirements for the integrated commercial-industrial district are the same for developments with water and sewer, and 40,000 sq. ft./150 ft. frontage without water and sewer. Residential minimum lot sizes are as follows: "A" - with water and sewer 15,000 sq. ft./100 ft. frontage, without 40,000 sq. ft./150 ft. frontage; "B" - with water and sewer 20,000 sq. ft./150 ft. frontage, without

60,000 sq. ft./225 ft. frontage; "R" - single-family 40,000 sq. ft./150 ft. frontage; two-family 80,000 sq. ft./225 ft. frontage. Cluster development is permitted in all residential districts with a minimum tract size of 5 acres with water and sewer or 20 acres without. Overall density is the same as would be permitted by the underlying zone and there are no minimum lot size, frontage or setback requirements.

In addition, the Town has adopted a number of regulations to protect its natural resources such as a floodplain management district, a wetland protection district and an aquifer protection district. The wetland protection district includes surface waters and establishes minimum setbacks for developments. The specifics of the wetland protection district are discussed in the Wetlands section.

Mont Vernon

Three zoning districts comprise the Mont Vernon section of the watershed. The residential district includes all land within 500 feet of the central points of identified streets and all land within the perimeter of the boundaries. The limited commercial district is located in the southeastern corner of the Town west of NH Route 13. All other lands within the Town are zoned rural-residential. The following uses are permitted in each of the districts:

Residential (333 acres): single-family residences and accessory uses; open space developments; permitted by special exception home occupations.

Rural-residential (7,943 acres): all uses permitted in the residential district; general purpose farming and forestry activities; the sale of home produce; open space developments; permitted by special exception home occupations.

Limited commercial (63 acres): retail, personal service and business establishments; business and professional offices; veterinary clinics; automotive service stations; wholesale and storage warehouses; indoor recreational activities and facilities; laboratory, office and research facilities; assembly of pre-manufactured products; general service and repair shops.

Standards for minimum lot sizes and frontages are based on soil capabilities and broken into five districts: District 1 deep to well drained soils with slight to moderate constraints 2 acre minimum lot size with 200 feet of frontage; District 2 soils with severe constraints and severe slope limitations five acre minimum lot size with 300 feet of frontage; District 3 includes all land within the Purgatory Brook watershed and requires a five acre minimum lot size with 300 feet of frontage; District 4 soils with wetland, floodplain or ledge constraints which are nonbuildable. District 5 all land bordering NH Route 13 to a depth of 200 feet with access on Route 13 has a 500 foot frontage requirement. Open space developments are permitted in both residential districts.

Lyndeborough

Lyndeborough's portion of the watershed is divided into five general zoning districts, village, light industrial, rural lands one, two and three. The village district is located along both sides of NH Route 31 north from the Wilton Town line to Cross Road. The light industrial district is situated in the southeast corner of the Town along the Mont Vernon border. The rest of the Town is in the rural lands districts which are unique in that they are based on elevation. Rural lands 1 covers all areas below 1,000 feet outside the village and light industrial districts; rural lands 2 covers elevations from 1,000 feet to 1,500 feet; and rural lands 3 includes everything over 1,500 feet. The following uses are permitted in each district and home occupations are permitted anywhere within Town:

Village (450 acres): single-family residential; retail stores; professional offices; banks; municipal, government or postal facilities; agricultural operations; permitted by special exception two-family dwellings, private schools, warehouses, automobile service stations, accessory apartments, personal service businesses and banks.

Light industrial (115 acres): light manufacturing; research and/or testing facilities; offices; newspaper printing facilities; warehouses; permitted by special exception vehicular sales and repair facilities, automobile service stations, contractor's yards, public assembly uses, single family dwellings and two-family dwellings.

Rural lands 1 (11,076 acres): agricultural operations; forestry resource and management; single family dwellings; seasonal dwellings; permitted by special exception two-family dwellings, accessory apartments.

Rural lands 2 (3,113 acres): single-family dwellings; agricultural operations; forestry resource and management; permitted by special exception two-family dwellings and accessory apartments.

Rural lands 3 (410 acres): agriculture and farming; forestry resource and management; permitted by special exception single-family dwellings.

The village district requires a minimum lot size of two acres with 150 feet of frontage. The light industrial and the rural lands 1 districts require 2 acre minimum lots with 250 feet of frontage while rural lands 2 and 3 require five and ten acres respectively with 500 feet of frontage. Additionally, the Town has adopted a wetland conservation district to protect sensitive areas from development.

Wilton

The majority of the watershed in Wilton is contained in the residential and residential/agricultural districts. Small commercial zones are located in the downtown and in two areas along NH 101. Three areas are zoned for industrial uses: the area between NH 101 and Main Street west of the Milford Town line, the area along NH Route 31 south of the Lyndeborough Town line, and an area along NH Routes 101 and 31 south. The office park district is located on NH 101 near the Temple Town line. The watershed district encompasses all lands in the northwest corner of the Town which drain into the reservoirs. The uses permitted within each district include:

Residential (469 acres): single-family and duplex dwellings and accessory uses; multi-family dwellings with 3 units; permitted by special exception home occupations, bed and breakfasts, churches, synagogues, parish houses and convents, hospitals, emergency medical centers and clinics, civic and municipal buildings, schools and daycare centers.

Residential/agricultural (14,118 acres including watershed overlay district). any use permitted in the residential district; and all general farming and forestry activities.

Commercial (46 acres): any use permitted in the residential and agricultural district; duplex and multi-family dwellings, inns, tourist courts, cabins, and bed and breakfasts; restaurants and other retail establishments; garages, parking lots and filling stations; business and professional offices; theaters, halls, clubs and amusement centers; greenhouses and florist shops; funeral homes; and wholesale establishments in connection with permitted retail establishments, warehousing or merchandise for sale within the district.

Industrial (760 acres): Manufacturing, compounding, processing, packing, treatment or warehousing of goods and products; research and/or testing laboratories; and offices; permitted by special exception commercial uses under the same terms and conditions as industrial uses.

Office Park (59 acres): corporate offices; research facilities; farming uses; permitted by special exception professional offices, real estate offices, service facilities, warehouse facilities, assembly and manufacturing facilities, and residential uses.

Watershed Overlay District (2,213 acres): residential and agricultural uses.

Minimum lot size in the residential district is half an acre with municipal water and sewer and one acre without water and sewer with 100 ft. frontage. Lot size in the residential agricultural district is either one, one and a half or two acres depending on soil conditions with 200 ft. of frontage. The commercial district does not establish a minimum lot size; however, it does establish a maximum lot coverage of 75 percent. The industrial district requires a two acre minimum lot size with 200 ft. of frontage and lot coverage cannot exceed 60 percent or 40 percent in the aquifer protection district. Cluster developments are permitted in the residential and agricultural district with a minimum tract area of 15 acres with 500 ft. of frontage; no minimum lot sizes or setbacks are established. The watershed district requires a minimum lot size of six acres excluding wetlands, floodplains and land within the deeded flowage rights of the State flood control system, and 300 feet of frontage on a Class V or better road. Development within this district must also meet stringent setback requirements and provide erosion and sedimentation control plans for any disturbance of slopes 15 percent or greater. In addition, the Town has adopted a number of regulations to protect its natural resources such as a floodplain conservation district, a wetland conservation district and an aquifer protection district.

Greenville

Greenville's zoning within the watershed is a mixture of rural/agricultural, residential, commercial and industrial. The industrial zone is situated in the northwest corner of the Town with commercial zones located along NH Route 31 and the Town center. These areas are surrounded by the rural/agricultural and residential districts. The following uses are permitted in each district:

Rural/agricultural (809 acres): single-family residences; convalescent or nursing homes; educational use, place of worship or public and semi-public nonprofit uses; veterinarian, commercial stable or kennel; general farming; roadside stands for the sale of produce grown on the premises; commercial agricultural uses; cemeteries; public utility installations; excavations of natural materials; accessory uses to permitted uses; home occupations; and start-up home businesses; permitted by special exception inn or tourist home.

Residential (541 acres): single-family residences; two-family residences; educational use, place of worship or public and semi-public nonprofit uses; public utility installations; accessory uses to permitted uses; home occupations; and start-up home businesses; permitted by special exception multi-family housing and inn or tourist home.

Commercial (306 acres): retail business establishments; professional offices; banks and financial institutions; real estate offices; restaurants, cafeteria, bakery and confectionery shops; grocery or general store; place of worship; inn or tourist home; indoor theater; private club; self-service storage centers; health care facilities; recreational facilities; building supply facilities; and accessory uses to permitted uses; permitted by special exception gasoline service station or garage, single-family residence, two-family residence; multi-family housing; and light industry.

Industrial (428 acres): any industry whose use or process is not obnoxious or offensive by reason of gas, radiation, odor, smoke, vibration, liquid discharge, illumination, noise or appearance and which does not constitute a public hazard whether by fire, explosion or otherwise; plants for the processing and distribution of milk and dairy products for human consumption and for bottling or packaging beverages, pharmaceuticals, and toilet preparations, perfumes and similar products; printing, publishing and general contractors; restaurant and cafeteria; and accessory uses to permitted uses; permitted by special exception uses permitted in the C and C-I districts.

Minimum lot size and frontage requirements for single family buildings are one acre/150 ft. frontage with municipal sewer and two acres/200 ft. frontage without. Minimum lot sizes for multi-family buildings range depending on the number of units in the structure. A half acre minimum lot size is required within the commercial district and a five acre minimum lot size is required in the industrial district, minimum frontage for both is 200 ft. regardless of the presence of municipal water or sewer service.

Greenfield

Greenfield's portion of the watershed is divided into three zones, general residence, rural/agriculture and industrial. The general residence district is located east and west of NH Route 31 and includes 400 feet on either side of New Boston Road. The industrial special purpose district is situated west of NH Route 31 and north of Gulf Road. The remainder of the watershed is zoned rural/agriculture. The following uses are permitted in each district:

General residence (3,536 acres): single-family dwellings; multi-family dwellings maximum of four units; buying, selling and exposing for sale home produce and products; hotels and tourist homes; sanitariums; private schools; recreational camps.

Rural/Agricultural (734 acres): single-family dwellings; multi-family dwellings maximum of four units; buying, selling and exposing for sale home produce and products; hotels and tourist homes; sanitariums; private schools; recreational camps.

Industrial (334 acres). industrial uses which are not injurious to agricultural enterprises or nearby private residences.

The general residence district requires a minimum lot size of two acres and 250 feet of frontage on a Class V or better highway. Multi-family dwellings must have one acre per dwelling unit. Four acre lots and 350 feet of frontage are required in the rural/agricultural district. The industrial district requires a 2 acre minimum lot size and 150 feet of frontage.

Temple

The Town of Temple is divided into three zoning districts. The village and historic preservation district includes all land within a one-quarter mile radius of the Town Hall. The rural residential and agricultural district is the largest district and includes all lands not contained in one of the other two districts. The mountain district encompasses the lands along the western and northern borders of the Town. The following uses are permitted in each district:

Village and historic preservation (125 acres): single-family and two-family residential uses; agricultural uses; home industries and professional services; permitted by special exception commercial or industrial uses of lands and buildings.

Rural residential and agricultural (10,098 acres): single-family and two-family residential uses; agricultural uses; home industries and professional services; mobile homes; planned residential developments; permitted by special exception commercial or industrial uses of lands and buildings, and mobile home parks.

Mountain (3,224 acres): single-family and two-family residential uses; agricultural uses; home industries and professional services; planned residential developments; permitted by special exception commercial or industrial uses of lands and buildings.

The village and historic preservation district requires a minimum lot size of two acres, frontage of 250 feet on a Class V or better road and the lot must be capable of containing a 200 foot by 200 foot square. Standards for the rural residential and agricultural district are three acre minimum lots, 300 feet of frontage on a Class V or better road and the lot must be capable of containing a 250 foot by 250 foot square. Developments in the mountain district need a five acre minimum lot, 350 feet of frontage on a Class V or better road and be capable of containing a 300 foot by 300 foot square. Planned residential developments must have a minimum tract size of six acres, 300 feet of frontage on a Class V or better road and 40 percent of the total tract area must be left as open space.

New Ipswich

The New Ipswich portion of the watershed is zoned rural except for three areas which are zoned village district I and village district II. Village district I includes the areas known as Bank Village and Smith Village, village district II encompasses New Ipswich Village. The village districts extend 350 feet from the center of the road or to the normal bank of natural bodies of water, whichever comes first. In addition, the Town has a steep slope overlay district which includes all areas with slopes in excess of 15 percent. The following uses are permitted in each district:

Village District I (158 acres): single-family dwellings and accessory uses; two-family dwellings and accessory uses; places of worship; permitted by special exception inns, bed and breakfasts, nursing and convalescent homes, daycare and day nurseries, and kindergartens, professional uses and home occupations; and multi-family dwellings.

Village District II (127 acres): single-family dwellings and accessory uses; two-family dwellings and accessory uses; places of worship; permitted by special exception inns, bed and breakfasts, nursing and convalescent homes, daycare and day nurseries, and kindergartens, professional uses and home occupations, multi-family dwellings, gas stations, auto service stations, eating and drinking establishments, instructional facilities, funeral homes, public buildings, office buildings, banks, small retail establishments and medical facilities.

Rural (13,322 acres): any use permitted in Village District I and II; mobile homes; residential cluster developments; agricultural uses; recreational uses; roadside stands; greenhouses; stables and riding schools; summer camps; permitted by special exception uses permitted by special exception in Village District I and II, commercial, business, industrial, excavations, group home, camping area, saw mills, slaughter houses, junk yard, heavy equipment business, light industry, veterinary clinics, kennels, residential cluster on tract less than 10 acres.

Steep slope: all uses permitted by right and by special exception in the underlying zone; development is prohibited in areas with slopes exceeding 25 percent.

Village Districts I and II require minimum lot sizes of one acre with 200 ft. of frontage. Minimum lot size in the rural district is two acres with 200 ft. of frontage. Structures, parking lots and leachfields must be set back 100 ft. from the normal bank of all lakes, ponds, rivers, streams and brooks. Minimum standards for the steep slope overlay district include a minimum lot size of three acres with 200 feet of frontage with one acre of contiguous area with slopes of 15 percent or less. Residential cluster developments require a minimum tract area of ten acres and 55 percent of the area must be maintained as open space. In addition, the Town has a floodplain district.

Ashby, MA

The Ashby portion of the watershed is entirely within the residential/agricultural zone. The following uses are permitted within this zone:

> *Residential/agricultural (2,748 acres):* agriculture on parcels five acres or greater; municipal, educational, religious or nonprofit institutional uses; single-family dwellings; home occupations; use of premises in connection with the trade of the resident; room rentals for not more than 3 non-transient persons; nursing homes, sanitariums, orphanages or similar use; retail sale of products of home occupation; farm orchard, greenhouse, tree nursery truck garden or wood lot including the sale of products; commercial raising of poultry, cattle, horses, goats, sheep, swine or other domestic farm animals; permitted by special exception library, club, sale or storage of feed, fuel, timber or building supplies, cemetery, golf course, riding stable, boat livery, ski trails and tows, campground, camp for children or adults, kennel or veterinary hospital, temporary use of mobile home, temporary use of cellar hole, hotel, motel, restaurant or liquor establishment.

Minimum lot size in the district is 80,000 square feet with 200 feet of frontage and building areas shall not exceed 35 percent of the total lot area.

Ashburnham, MA

The Ashburnham section of the watershed is zoned residential B. Uses permitted within the district include

> *Residential-B (2,610 acres):* church or other place of worship, parish house, rectory, convent and other religious institutions; schools, public and private; colleges or junior colleges; single-family residence; mobile home within a park; room rentals for not more than three transient persons; professional office or studio of a resident; home occupations; accessory uses; farms five acres or larger; sale of agricultural and horticultural products produced on site; commercial greenhouse; permitted by special exception nursery school or private camp, library, museum, or civic center, public government buildings, utility buildings and structures, hospitals, sanitariums, nursing, rest or convalescent homes, charitable institution or other non-correctional institutional use, country or tennis club or other nonprofit social, civic or recreational lodge or club, cemeteries, conversion of a single-family dwelling to two-family dwelling, tow-family or semi-attached dwelling, mobile home park, farms less than five acres, restaurants, drive-in or open-air restaurant, veterinary hospital, commercial sale, breeding or boarding of dogs, cats and other domestic pets, storage of construction equipment and building materials, tourist homes, hotels, motels or overnight cabins, airport or heliport, excavation or processing of soil, loam, sand, gravel, rock and other mineral deposits, scientific research and development and accessory uses.

The district requires a minimum lot size of 60,000 square feet with 200 feet of frontage and maximum lot coverage of 20 percent.

As described, a variety of zoning districts are found in the watershed. Some districts restrict land uses solely to residential uses while others allow a multitude of industrial and commercial developments. The dominant zone throughout the watershed is residential/rural residential. The significant threats to the river from these types of development are subsurface waste disposal and household applications of nutrients and pesticides. Groundwater and surface water contamination has occurred in a number of locations within the study corridor due to industrial and commercial land use activities and practices. The vacant industrially and commercially zoned lands adjacent to the river need to be developed with care to protect both surface water and groundwater quality.

Shoreline protection regulations could effectively be used to protect surface waters in the watershed from the negative impacts of future development and to ameliorate the impacts of existing development. For example, requiring minimum setbacks for site developments and maintenance of vegetative buffers can decrease the impact of riverfront development. These requirements protect water quality by providing a filter strip between the development and the surface water while maintaining the aesthetic character of the corridor. Maintenance of the vegetative buffer can also protect surface waters from the negative impacts of existing land uses. Limitations placed on the types of uses allowed within the shoreline zone will ensure that those land uses and activities that pose a significant threat to surface waters, such as landfills and junkyards, will be prohibited thereby reducing the potential impacts.

ROAD SYSTEMS

The road system within the Souhegan River Watershed includes the following major routes: NH 101, NH 101A, NH 31, NH 122, NH 123, NH 124, US 3 and the F.E. Everett Turnpike. Traffic counts within the watershed have been conducted by the NH Department of Transportation and the Nashua Regional Planning Commission, recent average vehicles per day (vpd) values for each road are as follows:

- NH 101 in Milford south of NH 101A – 15,377 vpd (1994)
- NH 101A in Hollis at the Merrimack-Milford line – 28,8841 vpd (1994)
- NH 31 in Lyndeborough at the Greenfield line – 2,540 vpd (1994)
- NH 122 in Amherst north of NH 101A – 7,487 vpd (1993)
- NH 123 and 124 in New Ipswich west o NH 123A – 5,400 vpd (1993)
- US 3 in Merrimack south of the Souhegan River – 20,043 vpd (1994)
- F.E. Everett Turnpike in Merrimack at the exit 12 toll booth – 31,420 vpd (1994)

Future road improvements scheduled for these routes as identified in the NRPC's *Transportation Improvement Program, Fiscal Years 1995 to 2004*, include:

- signalize the NH 101/Wilton Road intersection in Milford
- rehabilitate the F.E. Everett Turnpike bridge over the Souhegan River in Merrimack
- rehabilitate the NH 122 bridge over the Souhegan River in Amherst

In addition to these improvements, Chapter 239, laws of New Hampshire 1994, directs the New Hampshire Department of Transportation (NH DOT) to establish a pilot program to test reduced salt use for winter ice removal in the towns of Amherst, Brookline and Merrimack. The NH DOT has established this program with local approval for portions of NH 130 in Brookline, NH 122 in Amherst and Route 3 in Merrimack.

NH routes 101, 101A and 31 run parallel to the River for much of its distance. These routes carry thousands of cars each day and provide easy access to the River corridor from all over southern New Hampshire and northern Massachusetts. The western stretch of Route 31 south in Wilton even provides direct public access to the river in a few locations within the NH Department of Transportation's scenic easement. Major routes also

provide public access where they cross the River. One such access is located in Amherst where Route 122 crosses the River and another exists in Merrimack at Seaverns Bridge. Additional access to the River is provided by collector and local roads. The opportunities that roadway river crossings and construction projects provide for developing public access to the River should not be ignored. The subject of public access should be brought up whenever roadway projects near the River are discussed at the state and local level.

RECREATION

Numerous public and private recreational opportunities exist in the Souhegan River watershed. Residents of the communities in the watershed, the region, New Hampshire and other states utilize these recreational resources. Activities such as canoeing and kayaking take place on the river and its larger tributaries while fishing and swimming take place on surface waters throughout the watershed. Hiking, cross country skiing, picnicking, bird-watching, nature study, hunting and general enjoyment and appreciation of the natural surroundings are constant activities in the watershed. Numerous state and federal studies have identified the need for increased recreation areas and facilities to serve an ever growing and changing population.

The increase in the region's population during the past 20 years has resulted in a corresponding expansion of overall demand for recreation. Demographic changes within the population have also had a significant impact on recreational demand. Americans are living longer and remaining active; single parent families are increasing; the alleged increase in leisure time is not evenly divided among the various sectors of the population; dual income families are common and often a necessity; and different income groups have access to different recreation opportunities. Older people are involved in more passive, less intense activities such as walking and nature study. Single parent and dual income families generally have less time for leisure activities and therefore must utilize recreation areas that are closer to home and available for use after work or on weekends. The overall result is a need for increased recreational opportunities of all types closer to the population centers.

The Souhegan River and its watershed can provide many recreational opportunities to meet these demands. The watershed is situated such that the recreational opportunities it provides are available to a large and diverse population. Hiking and cross country skiing trails could follow the riverbank and connect with existing trails, public and private parks, and conservation areas. The River itself provides opportunities for canoeing, kayaking, fishing and swimming.

Public and private conservation, recreation and river access points are indicated on Map IV-3. Public recreation and conservation lands are owned by the federal, state or local government or by a private organization that permits public access and are open to the general public for use. Private conservation and recreation lands are owned by a private entity and may or may not be open to use by the general public or may be used for a fee. Table IV-3 provides a breakdown of recreation and conservation land area by community. Recreation and conservation lands represent approximately 8.2 percent of the total watershed area with a total of 8,973 acres.

Boating

Boating within much of the Souhegan River watershed is limited to canoes and kayaks. Larger watercraft are limited to the few lakes that can support their activities. The western sections of the Souhegan River from Greenville to Wilton provide whitewater canoeing and kayaking during the spring and other periods of high water. These sections of the river are identified as good intermediate whitewater by both the Appalachian Mountain Club's (AMC) River Guide, and the New England Whitewater River Guide. The AMC Guide classifies the rapids in this section as Class II, III and IV. This stretch of the River is very popular with canoers and kayakers because it provides good training runs, the water is clean, the area is easily accessed and

the ice melts early in the spring. The Boston and New Hampshire AMCs and the Merrimack Valley Paddlers organize numerous trips on the Souhegan River every year.

TABLE IV-3
SOUHEGAN RIVER WATERSHED
RECREATION AND CONSERVATION LANDS

Town	*Public*	*Private*	*TOTAL*
Amherst	741	331	1,072
Ashburnham, MA	180	19	199
Ashby, MA	66	172	238
Greenfield	1,154	0	1,154
Greenville	277	0	277
Lyndeborough	392	0	392
Merrimack	159	22	181
Milford	835	0	835
Mont Vernon	422	0	422
New Ipswich	208	340	548
Temple	1,722	744	2,466
Wilton	915	257	1,172
TOTAL	7,071	1,885	8,956

All figures rounded to nearest acre.
Source: Municipal and state records of open space and recreation lands interpreted on the NRPC GIS system, 1994.

The stretch of the River between Wilton and Milford provides limited opportunities for canoeing and kayaking because the water is generally very low and portages are required around the dams. Below the Route 122 bridge in Amherst the River is flat and provides excellent opportunities for family canoe outings. The water is shallow with a sandy bottom and there are numerous spots to picnic and wade. The Merrimack Chapter of the Merrimack River Watershed Council sponsors annual trips on this section of the River. Below the Seaverns Bridge in Merrimack, the River quickens as it flows through a series of ledges called Indian Ledges. Passage for canoes and kayaks at this point is again limited to periods of high water. The stretch of River below Seaverns Bridge is impassable to watercraft because of Wildcat Falls.

The importance of providing legal access for River users cannot be over emphasized. It is also critical that sufficient parking be provided at put-ins and take-outs to alleviate problems with the surrounding neighborhood. If the river access is located on private property, river users should seek permission to use the access from the owner and respect the rights of the property owner by leaving the area in the same condition as they found it.

Overall, despite the popularity of the Souhegan River in the spring, the recreational opportunities for canoeing and kayaking are underutilized. The Amherst-Merrimack stretch of the river provides opportunities for family canoeing throughout the summer. The memories of childhood experiences travel with us throughout our lives and can form the basis for involvement with river organizations and the general community in later years.

Swimming

Swimming in the Souhegan River is limited to a few areas where the River is deep enough. Wading and rock jumping, however, take place all along the River. Three areas identified by the advisory committee, the Horseshoe in Wilton, the confluence of Purgatory Brook in Milford, and the Town access off Boston Post Road in Amherst are regularly used by residents for swimming. The Horseshoe is used extensively throughout the summer; however, it is located on private property. The Town of Wilton's attempts to purchase the Horseshoe a few years ago were unsuccessful. Given the change in the real estate market, the time may be right to again attempt to protect this historic swimming hole. The Milford site is accessible over property owned by the State and is therefore protected from future development. The swimming area and canoe access in Amherst is located on Town conservation land. Swimming in the tributaries is also limited to areas with deeper pools. The Towns of Wilton and Lyndeborough developed a public swimming area on a dammed section of Stony Brook. Wading and rock jumping take place all along the river. One popular location is in Wilton along the DOT's scenic easement on Route 31 south. Picnic tables and a limited amount of parking are provided in two locations along the easement and are popular with residents and travelers.

Water quality is also a limiting factor for swimming in the Souhegan River. For the past four years, the Merrimack River Watershed Council has a citizen monitoring program identified areas where the water quality poses a potential health risk for swimming. These areas are discussed in the Water Quality section and identified on Map III-2.

Fishing

Fishing for such species as small mouth bass, rainbow trout, brown trout and brook trout is a popular activity in the Souhegan River watershed. The NH Department of Fish and Game annually stocks the Souhegan River and the larger tributaries with rainbow, brown and brook trout. When released, the trout are of a legal size for angling, representing what is called a "put and take" program. Access to the River and its tributaries for fishing is also of concern and needs to be addressed.

Hiking

Participation in hiking, walking and other trail activities like jogging and cross country skiing is increasing rapidly throughout the nation as evidenced by their high marks in the National Park Service's 1982-1983 Nationwide Recreation Survey. Walking ranked number one with a 53 percent participation rate. The Souhegan River corridor provides a natural route for walking and hiking in a scenic environment. Hiking currently takes place along the River in most locations where permitted on public property or by permission of the landowner. Public access is again the major problem with regard to use of the River corridor for hiking and the potential for developing a continuous trail along the River.

Trail systems currently exist in many of the conservation and recreation areas in the watershed identified on Map IV-3. Each community has at least one area with developed trails: the 80 Acres site in Merrimack; the Tucker Brook Town Forest and the fish hatchery land in Milford; Joe English Brook and Ponemah Bog in Amherst; the Wapack National Wildlife Refuge in Greenfield, Temple and Lyndeborough; the Lamson Farm and Purgatory Reservation in Mont Vernon; Binney Pond State Forest in New Ipswich; Miller State Park and North Pack Monadnock in Temple; and the Heald Tract in Temple and Wilton. There is not, however, an interconnected trail system along the Souhegan River.

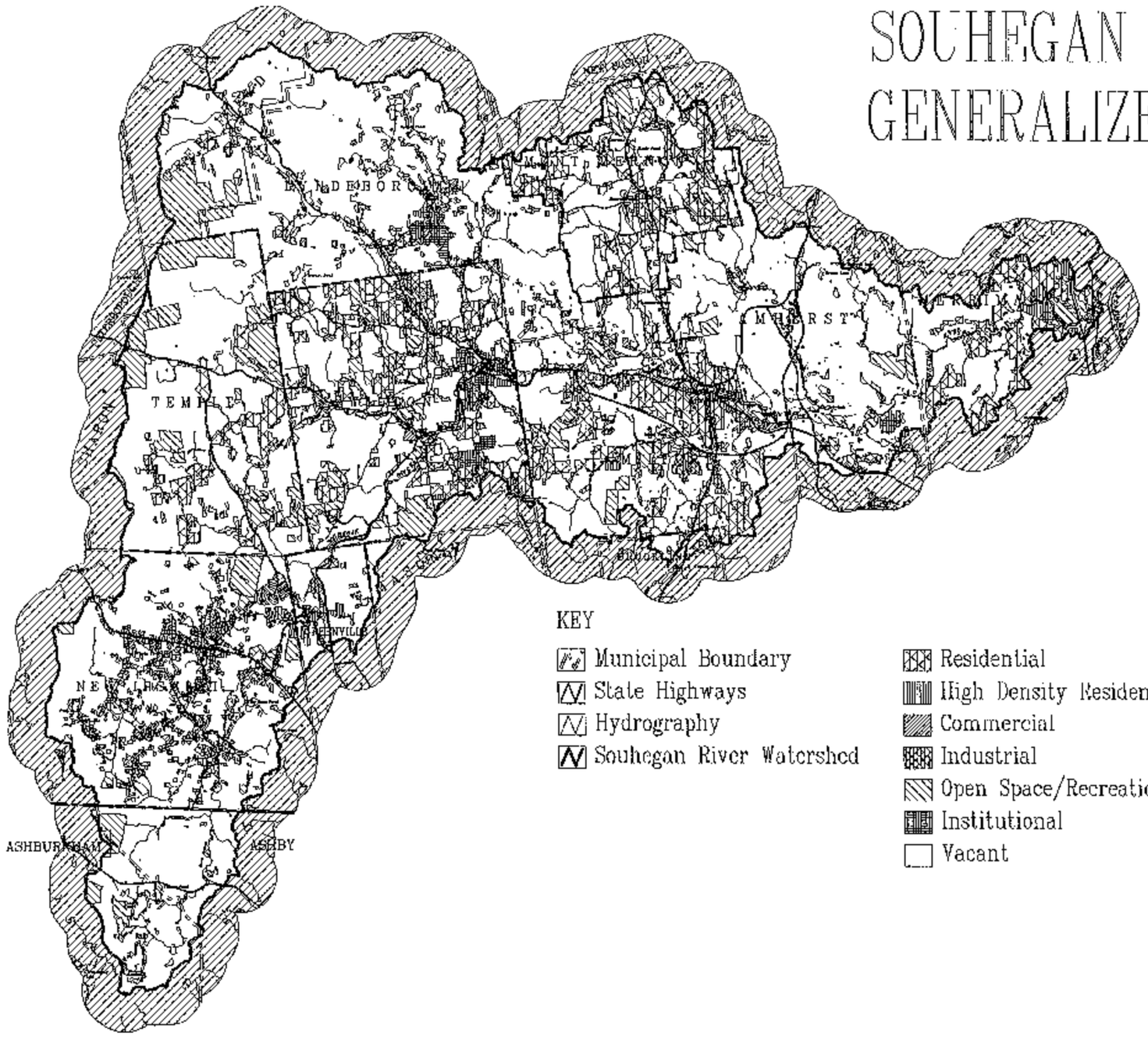
The potential for developing a trail along the Souhegan River is great at a time when there is significant public interest in river trails. If developed, the trail would serve the recreational needs of a large population and further increase the River's constituency. A trail along the River could ultimately connect the existing public conservation and recreation areas. A regional group has begun discussing the potential of developing a

continuous trail along the Souhegan River and the Town of Milford is developing plans for a river trail. Assistance in trail planning, design and construction is available from numerous trail organizations including: the NH Department of Parks and Recreation Trails Bureau, the AMC, Trailwrights and Friends of the Wapack Range.

#500F-10

MAP IV-1

SOUHEGAN RIVER WATERSHED GENERALIZED LAND USE



KEY

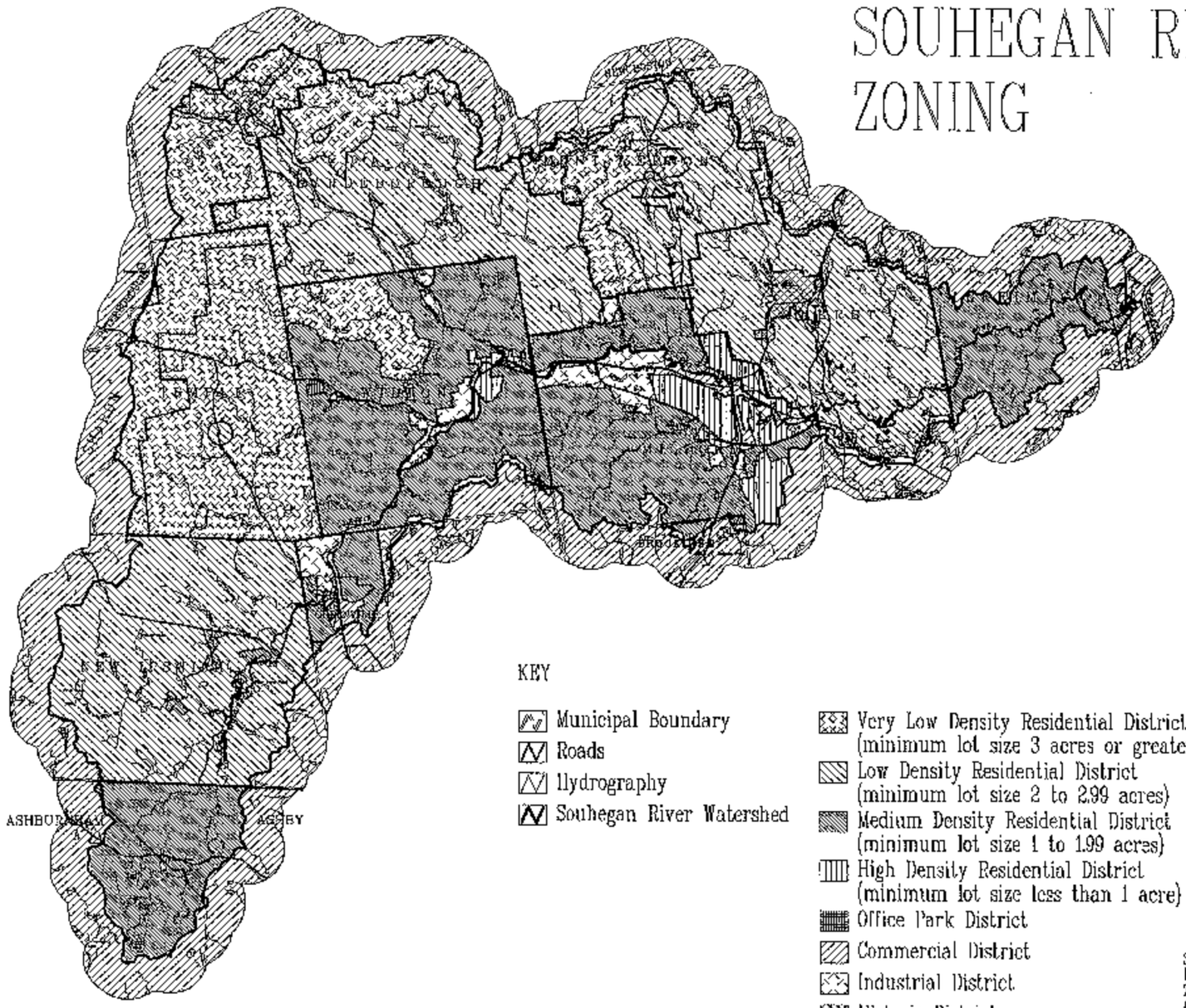
- Municipal Boundary
- State Highways
- Hydrography
- Souhegan River Watershed
- Residential
- High Density Residential
- Commercial
- Industrial
- Open Space/Recreation
- Institutional
- Vacant

N

Source: Data prepared by NH Department of Environmental Services Based on 1:24000 USGS DLGs as prepared by UNH Complex Systems Research Center.
Generalized Land Use: Prepared by the Nashua Regional Planning Commission, 1993. Based on local land use information and windshield surveys, 1992–1994.
Map prepared by the Nashua Regional Planning Commission.
Date Created: Oct. 30, 1992. Date Printed: May 29, 1994.

MAP IV-2

SOUHEGAN RIVER WATERSHED ZONING



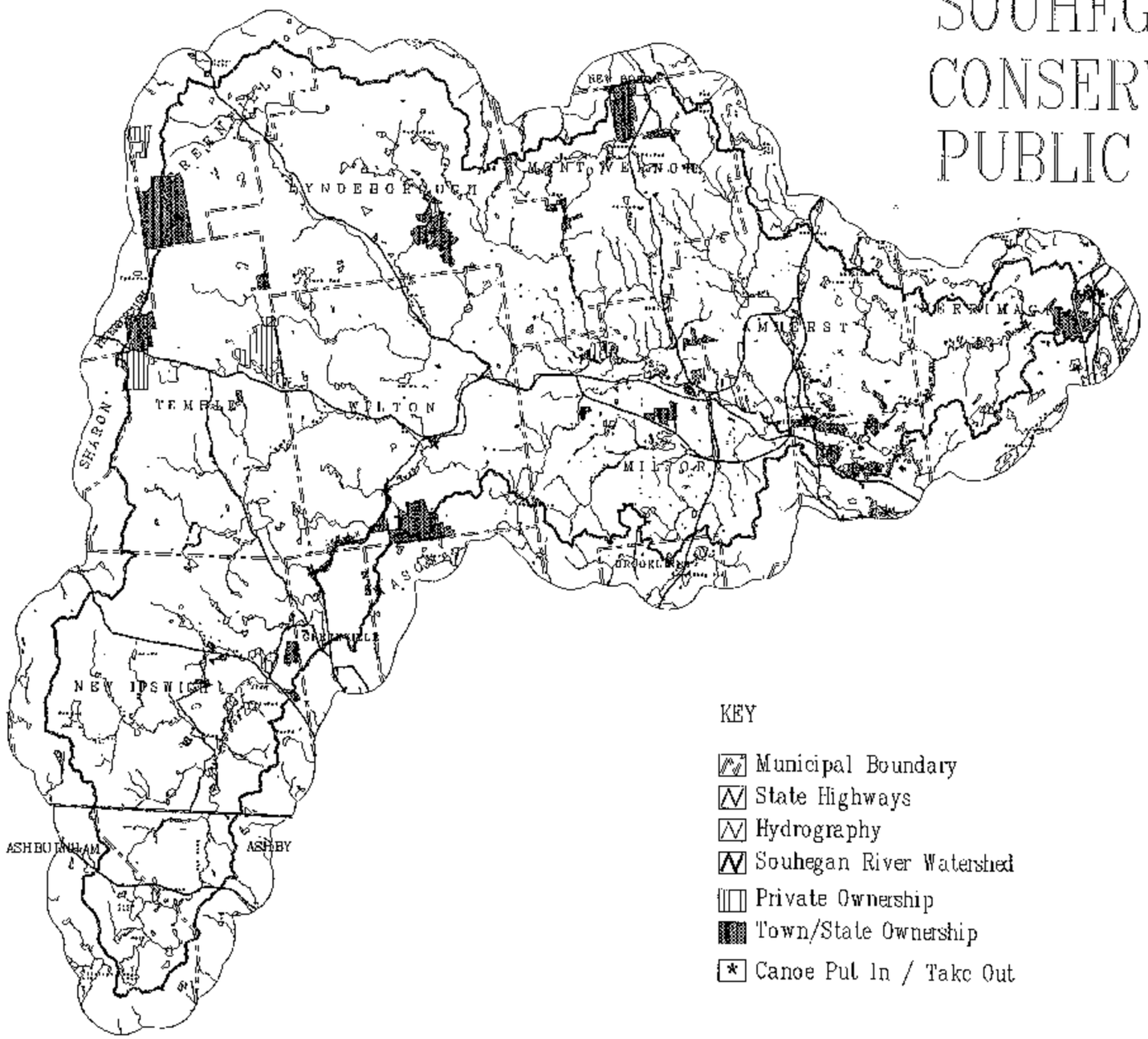
KEY

- Municipal Boundary
- Roads
- Hydrography
- Souhegan River Watershed
- Very Low Density Residential District (minimum lot size 3 acres or greater)
- Low Density Residential District (minimum lot size 2 to 2.99 acres)
- Medium Density Residential District (minimum lot size 1 to 1.99 acres)
- High Density Residential District (minimum lot size less than 1 acre)
- Office Park District
- Commercial District
- Industrial District
- Historic District

Source: Data prepared by NH Department of Environmental Services
Based on 1:24000 USGS DLGs as prepared by UNH Complex Systems Research Center.
Zoning: Prepared by the Nashua Regional Planning Commission, 1993. Based on local zoning maps as of May 19, 1994.
Zoning is for general purposes only, and should not be used to determine zoning classifications of specific parcels.
Date Created: Oct. 30, 1992. Date Printed: July 12, 1994.

MAP IV-3

SOUHEGAN RIVER WATERS CONSERVATION, RECREATION & PUBLIC ACCESS POINTS



KEY

- Municipal Boundary
- State Highways
- Hydrography
- Souhegan River Watershed
- Private Ownership
- Town/State Ownership
- * Canoe Put In / Take Out

N

Source: Data prepared by NH Department of Environmental Services
Based on 124000 USGS DLGs as prepared by UNH Complex Systems ResearchCente
Conservation lands layer prepared by the Southwest Regional Planning Commission, 1993. Recreation lands and canoe takeout/put-in information prepared by the Nashua Regional Planning Commission.
Date Created: Oct 30, 1992. Date Printed: Feb. 17, 1994.

SECTION V:

ANALYSIS

SECTION V: ANALYSIS

Previous sections provide information on current conditions within the Souhegan River watershed. This section examines the information with regard to the identified desired uses of the River and takes it one step further by theorizing what will have to occur within the watershed to either maintain or achieve these uses. The section begins with a discussion of the recommendations of previous programs directly or indirectly related to the River and the watershed. Then a future development capability analysis for the watershed was conducted. The three sections remaining include a water quality analysis comparing the desired uses with current information; an assessment of local best management practices; and an overall analysis of the information by the Advisory Committee.

PREVIOUS PROGRAM RECOMMENDATIONS

On November 13, 1993, the Nashua Regional Planning Commission sponsored a public meeting to discuss the Souhegan River. Participants divided into smaller discussion groups and were asked to identify the important uses, values and attributes of the Souhegan River. The groups were brought back together and a single list was compiled. To facilitate ranking of the listed items, each participant was given five dots and asked to identify their top five choices. This process resulted in the identification and ranking of the following uses, values and attributes for the Souhegan River.

Recreation
2. Water Supply
Wildlife Habitat
Water Quantity-Flow
3. Educational Resource
4. Waste Assimilation
5. Aesthetics-Scenery
6. Agriculture
7. Economic Returns (tourism, industry)
Historic Resources-Attributes
Cultural Resources
8. Hydropower

The purpose of this section is to evaluate the impact of previous program recommendations on the uses, values and attributes identified above for the Souhegan River. There are common threads between all of the uses identified and recommendations made specifically for one use will have an impact on the quality of other uses. Few studies have been done on the Souhegan River, thus, there are few River specific program recommendations. This section will discuss the program recommendations specific to the Souhegan River as well as some of the more general recommendations of other programs.

In order to support the activities identified above, an adequate level of water quality and quantity must be maintained. Water quality is directly linked to the use of the River for recreation, wildlife habitat, water supply, waste assimilation, agriculture and education. The NH Department of Environmental Services (DES) tests the water quality in the Souhegan River on an average of three times per year. Based on these snapshots of the River, assessments are made to determine if the River is meeting the water quality standards established for a Class B - fishable/swimmable - water. The 1992 New Hampshire Water Quality Report to Congress - 305(b) identified five areas on the Souhegan River which did not meet the water quality standards or only partially met the standards. In all instances, bacteria and dissolved oxygen were the standards violated. Bacteria is directly related to contact recreation while the fish and other aquatic species in the River are

dependent on adequate levels of dissolved oxygen for survival. In all instances the 1992 305(b) Report required action is an investigation to isolate the source and cause of the violation. At present, these investigations are ongoing; however, one source in Wilton has been identified and appropriate actions taken to rectify the situation. Also with regard to water quality, the Milford wastewater treatment facility is scheduled to receive a loan from the DES State Water Pollution Control Revolving Loan Fund in FY 1995 to upgrade the treatment plant. The 1994 Section 305(b) Water Quality Report identified only one area, near the Route 13 bridge in Milford, as nonsupporting due to bacteria.

In addition to the 305(b) Report, the DES conducted a Wasteload Allocation Study (WLA) on the Souhegan River in 1990 and 1991, at the request of the Town of Amherst, to determine the water quality impact of developing a treatment facility at the Bon Terrain industrial area which would indirectly discharge waste to groundwater. The Study also assessed the impact of the Bon Terrain discharge on the existing discharge from the Milford wastewater treatment facility. The Study recommended that sewage from the Bon Terrain facility be collected and pumped to Milford for treatment and that the Milford outfall be relocated to a site downstream of Beaver Brook as the most environmentally attractive option. At present, the two communities are discussing the options outlined in the Study.

A study released by the Environmental Protection Agency on the Fletcher Paint hazardous waste site in Milford found "potential for health effects from long-term exposure to the sediments and soil through contact or ingestion while swimming or wading in the Souhegan River behind the site." The NH Division of Public Health Services recommends that the area of the River adjacent to the site not be used for general recreational purposes. The EPA completed its investigation of the contamination at the Fletcher's site in July of 1994. In February 1995, EPA released a fact sheet discussing the results of the studies conducted on the site and answering general questions. The studies have found that the levels of polychlorinated biphenyls (PCBs) at both the Elm Street and Mill Street sites pose a long-term health risk. In addition, the studies determined that the major ground water contaminants beneath Keyes Park are associated with petroleum products. Based on this, the NH Department of Environmental Services is requiring the gas station on Elm Street to conduct a site investigation. The plume of contaminated ground water stretches from the Mill Street site northeast to the Souhegan River. Contaminants are reaching the Souhegan River both through the groundwater and through the drainage ditch/culvert system from Mill Street. EPA will be conducting additional studies to evaluate the ecological impacts of the contamination including the potential accumulation of contaminants in fish in the River.

The Souhegan River is targeted as a high priority surface water in the New Hampshire Nonpoint Source Pollution Management Plan, published in 1989. The goal of the plan is to present a strategy and implementation program to control nonpoint pollution sources (NPSs) to ensure that surface and ground water quality standards are met and that legislative classifications of waterbodies are attained and maintained. The plan identifies existing NPS programs and discusses strategies and actions to address NPSs throughout the State. There are no recommendations specific to the Souhegan River; however, most of the strategies and action plans outlined will have an overall impact on water quality.

Water quantity or flow is also important to the uses identified above and is directly related to recreation, wildlife habitat, waste assimilation, water supply, aesthetics, agriculture, economic returns and hydropower. Many of these uses would be significantly impaired or cease to exist without adequate water. Water flow in the Souhegan River fluctuates greatly throughout the year from an average of 818 cfs in April to 39 cfs in September.

The DES Water Resources Division Water User Registration Program requires all users which use 20,000 or more gallons of surface or groundwater per day averaged over a seven day period to register with the Division and provide WRD with quarterly reports of monthly water use. The WRD information for the Souhegan River

is good; however, it may not be complete as uses may exist which have not yet registered with the program. This information is essential to understanding the availability of water in the Souhegan River and the cumulative impact of withdrawals, establishing minimum instream flows and maintaining a balance between competing uses particularly during periods of low flows.

Within the watershed, groundwater is the primary source of both residential and municipal water supplies. Wilton, Milford and Amherst rely on groundwater for all or part of their municipal supply; however, Milford and Amherst do supplement the well supplies with water from Pennichuck Water Works during periods of peak demand. Greenville is the only community in the watershed with a surface water supply which is owned and operated by the State of New Hampshire. Merrimack, Milford and Wilton have completed wellhead protection studies. Merrimack completed a Phase I delineation with the assistance of the NH DES and is now working on the second phase of the study. The Town of Milford completed a Phase I delineation and an inventory of the potential contamination sources following the guidelines established by the New Hampshire Wellhead Protection Program. The Milford study recommends the adoption of an intermunicipal agreement between Milford and Amherst, two of Milford's wells are located in Amherst, for management of the wellhead protection area; the reclassification of the groundwater in the wellhead protection areas for the wells; and the adoption of local health ordinance for wellhead protection. At present the two communities are working out the terms of the intermunicipal agreement. The Wilton project was conducted by the EPA and involved a delineation which exceeds the Phase I delineation of the NH Wellhead Protection Program. The EPA recommends that the Town continue the process by conducting the inventory of the potential contamination sources and other actions in accordance with the NH Wellhead Protection Program.

The Souhegan River provides an opportunity for the development of an interdisciplinary curriculum incorporating science, math, English, history and government. The majority of the high schools in the watershed are either directly adjacent to the River or located within close proximity to the River. A number of the high schools in the watershed participate in the bi-state Merrimack River education program sponsored by the NH Fish and Game Department. In addition to the school programs, the Merrimack River Watershed Council sponsors annual canoe trips on the Souhegan to increase public awareness of the River and its recreational opportunities. The educational resources provided by the River, however, are underutilized and the potential for community education is untapped.

The scenic views along the Souhegan River are protected in west Wilton and Greenville along NH Route 31 by a scenic easement controlled by the Department of Transportation. Aside from this, views of the River are only protected on conservation lands along the River.

There are five small hydropower facilities operating on the Souhegan River. In addition, there are two dams with the potential to be retrofitted for power generation. The conversion of existing dams on the River to the production of electricity has been supported in the watershed.

DEVELOPMENT CAPABILITY ANALYSIS

The information gathered in previous sections of the study can be used to assess the development capability of the watershed. Development capability is basically an estimate of future development potential and is based on a number of characteristics such as the physical constraints of the land, existing development, property ownership, and infrastructure. The analysis also establishes assumptions under which the assessment is conducted such as is there likely to be a zoning change that would increase the density of development or will the extension of water and sewer systems increase the development potential of land which is currently vacant.

The initial step in conducting the development capability analysis for the Souhegan River watershed involved identifying the vacant developable land in each community. Vacant developable land was calculated by

subtracting the area of undevelopable land from the entire area of the watershed. Three categories of undevelopable land were used in this assessment: developed land, soils with a very low potential rating for septic systems and municipal well protective radii.

The developed land category includes residential, commercial, and industrial development, recreation land, conservation land, institutional land, roads and surface water. Agricultural land is included in the developed land category only if a permanent development restriction exists on a parcel. All other agricultural land is considered to have the potential of being converted to another use.

The very low potential rating for septic systems category was selected for a number of reasons. First, the wastewater disposal needs for the majority of the watershed are served by septic systems. Second, the category includes floodplain and wetland soils. Third, areas limited by steep slopes (generally greater than 25 percent), shallow depth to bedrock and high water tables are included in the category. And finally, the category considers areas with very high permeabilities unsuitable for septic systems. As discussed in the earlier section on Soil Septic System Capability, the soil potential ratings for septic systems were developed by the Soil Conservation Service for Hillsborough County, NH in 1986 and for Middlesex County in MA in 1985 as a tool to guide development. Since the soil potential ratings are based on the SCS soil surveys, they suffer from the same inherent problem of scale; however, the information is adequate for general planning purposes and the needs of this study.

The protective well radius for a municipal water supply well, as established by the NH DES Water Supply and Pollution Control Division "Subdivision and Individual Sewage Disposal System Design Rules", is 400 feet. Development within this area is severely limited.

Combined, these three categories appropriately depict the undevelopable land within the watershed. Based on this analysis there are a total of 40,904 acres of vacant developable land within the watershed, approximately 38 percent. The vacant developable land is distributed quite evenly between the communities in New Hampshire ranging from 31 percent in Wilton to 51 percent in Mont Vernon. The Massachusetts portion of the watershed is less developed with approximately 74 percent developable land in Ashburnham and 55 percent in Ashby. The Ashburnham figure is falsely inflated since soil information for Worcester County is not yet available in a digital format and therefore the limiting characteristics of the soil cannot be ascertained. Vacant developable land is depicted on Map V-1 while Table V-1 contains the actual figures by community.

A set of assumptions was established and used to project the development potential for the vacant land. The assumptions facilitate the conversion of the vacant developable land into dwelling units and population. The assumptions for this analysis are as follows:

- The zoning in each community will remain relatively unchanged.
- Since there are no planned municipal expansions of the water and sewer systems, significant expansion of the service areas are not expected.
- The persons per dwelling unit figure will remain relatively constant at the 1990 Census rate.
- A standard 10 percent is subtracted from the vacant developable acres for roads and utilities.
- Existing development will remain at the same density.
- Existing recreation, conservation, institutional and publicly owned lands will not be converted to another use.

Having made these assumptions, it is now possible to assess the maximum potential for future development or buildout of the vacant developable land within the watershed on a town by town basis.

Approximately 96 percent of the vacant developable land within the watershed is zoned for residential uses. Given the density prescribed by the existing zoning in each community, the maximum number of dwelling units for the vacant developable land can be calculated. The maximum development or buildout scenario would result in an additional 21,765 dwelling units in the watershed representing an increase of 168 percent over the 1990 figure of 12,955. The figures for each community are presented in Table V-1

The dwelling unit figure can then be multiplied by the average persons per dwelling unit for each community from the 1990 Census to arrive at an estimate of the future population. Based on this analysis, the population of the watershed would increase 168 percent from a current population of 35,047 to 94,029 if all of the residential vacant developable land were developed under the existing conditions. Table V-1 illustrates the increase in population for each community in the watershed.

TABLE V-1

SOUHEGAN RIVER WATERSHED

DEVELOPMENT CAPABILITY ANALYSIS

Community	*Vacant Developable Acres*	*Acres Developable Residentially*	*Acres Developable Non-Residentially*	*Future Added Dwellings*	*Existing Persons Per Dwelling*	*Added Population*	*Existing 1990 Population*	*Future Buildout Population*
Amherst	4,363	4,335	28	1,912	2.90	5,545	6,236	11,781
Ashburnham, MA	1,938	1,938	0	1,267	2.38	3,015	133	3,148
Ashby, MA	1,508	1,508	0	985	2.83	2,788	119	2,907
Brookline	98	98	0	49	3.03	148	100	248
Greenfield	1,514	1,269	245	374	2.42	905	196	1,101
Greenville	757	453	304	265	2.35	623	1,162	1,785
Lyndeborough	5,043	4,962	81	1,982	2.68	5,312	1,151	6,463
Mason	36	36	0	16	3.17	51	19	70
Merrimack	1,781	1,776	5	1,740	3.09	5,377	5,577	10,954
Milford	5,193	4,671	522	5,062	2.45	12,402	11,253	23,655
Mont Vernon	4,251	4,228	23	1,411	2.96	4,177	1,525	5,702
New Ipswich	5,190	5,190	0	2,639	3.03	7,996	3,520	11,516
Temple	4,450	4,450	0	1,313	2.80	3,675	1,136	4,811
Wilton	4,782	4,457	325	2,750	2.47	6,793	2,920	9,713
TOTALS:	*40,904*	*39,371*	*1,533*	*21,765*	*2.71*	*58,806*	*35,047*	*93,853*

All figures in acres rounded to nearest acre.
All zoning as of May 15, 1994.
Ten percent of residentially developable area has been subtracted for roads to compute future added dwellings.
Developable land is land which is not poorly or very poorly drained soil, not very low appropriateness for septic systems, and not already developed.
Ashburnham information does not account for steep slopes and septic limitations as this information is not available.

The remaining 4 percent of developable land, 1,533 acres, is zoned for commercial and industrial uses. The bulk of the area, 1,396 acres, is located in the Towns of Greenfield, Greenville, Milford and Wilton. Given the diversity of zoning regulations in the watershed it would be extremely difficult to project future development for commercial and industrial uses. Commercial and industrial development is further limited by the presence or absence of municipal water and sewer systems. In addition, given the current economy and the abundance of vacant commercial and industrial space existing within the watershed, a significant amount of new commercial and industrial development is not anticipated at this time.

The analysis in this section represents a maximum development scenario. While this is useful information, it is unreasonable to even consider that the existing conditions will change so drastically as to fulfill this scenario in the near future. A more reasonable assessment would be to project population and dwelling units based on the Office of State Planning (OSP) population projections. The 1993 OSP population projections forecast a 21 percent increase in the population of Hillsborough County from 1990 to 2015. Given the existing conditions, it is unlikely that any of the communities in the watershed will exhibit growth patterns significantly different than the County. Carrying forward the 21 percent growth rate would result in a watershed population of 42,407 in the year 2015, an estimated increase of 7,360 people and 2,716 dwelling units based on the average of 2.71 persons per unit for the watershed.

WATER QUALITY ANALYSIS

Of the twelve uses and values identified for the Souhegan River, six can be directly linked to water quality and water quantity. The standards and requirements for three areas, contact recreation, fisheries habitat and water flow, will be discussed in this section.

Contact Recreation

The Souhegan River and all of its tributaries are legislatively classified as Class B waters, acceptable for fishing and swimming or other recreational uses. The NH Water Quality Standards for Class B waters are as follows: pH - 6.5-8.0; dissolved oxygen (DO) - minimum of 75 percent saturation which is approximately equivalent to 6.0 mg/l; E. coli bacteria - geometric mean of 126 E. coli/100 ml for 3 samples obtained over a 60 day period or 406 E. coli/100 ml for a single sample and for designated beach areas a geometric mean of 47 E. coli/100 ml or a single sample of 88 E. coli/100 ml. The NH Department of Environmental Services (DES) conducts monitoring of the State's surface waters on an annual basis. Only one site on the Souhegan River, SHG-2 located below the NH Route 3 Bridge in Merrimack, is monitored on an annual basis (this was the only site monitored in 1992). Other sites on the River are monitored on a more sporadic basis as the need arises for information or as water quality problems are identified. The results of the annual testing for SHG 2 are presented in Table V-2. The State Water Quality Standards do not provide a numerical standard for phosphorous; however, previous studies have used 0.05 mg/l as an indicator of a level of concern.

Compared to the State standards, every sample met the pH standard and the single sample standard for E. coli bacteria; only one sample did not meet the DO standard; and four samples exceeded the 0.05 level of concern for phosphorous. These samples represent the conditions at the mouth of the River, the only site annually sampled by the DES.

Conditions upstream are not monitored by the DES on an annual basis; however, in 1990 the DES conducted a Wasteload Allocation Study for the Souhegan which required more intense sampling. In addition to SHG-2, seven sites were sampled on the mainstem between the Turkey Hill Road bridge in Merrimack and the PSNH complex in Milford. Ten samples were collected on six different days from June to September. Annually, DES focuses its monitoring on a specific basin which is sampled more intensely, the 1991 monitoring season focused on the Merrimack River basin and seven stations were monitored on the Souhegan River, while nine sites between Wilton and Milford were sampled in 1993 in addition to SHG-2 at the mouth of the River. In 1992 sampling was conducted only at SHG-2 at the mouth of the River.

The results of the 1990 Waste Load Allocation Study indicated that below the Turkey Hill Road bridge in Merrimack the water quality standards were met for all samples. Moving upstream from Merrimack, bacterial

violations and increased nutrient levels occurred in Milford and Amherst. Of particular concern is the site at Boston Post Road in Amherst which is used for swimming during the summer. The single sample standard of 88 E. coli/100 ml was violated on every sampling date, except for the first two samples in June and early July, representing a health risk to swimmers.

TABLE V-2
SOUHEGAN RIVER WATERSHED
ANNUAL WATER QUALITY RESULTS FOR SITE SHG-2
(MERRIMACK BELOW THE NH ROUTE 3 BRIDGE)

Date of Sample	*pH (units)*	*E. coli (per 100 ml)*	*DO (mg/l)*	*Phosphorous*
7/11/89		90	8.9	0.043
8/8/89	7.6	90	8.8	***0.062***
6/1/90	6.8	<30	10.6	
7/11/90	7.2	40	9.1	0.049
7/16/90	7.3	<30		0.048
6/10/91	7.2	90	9.2	***0.061***
7/18/91	7.1	70	8.7	***0.053***
8/12/91	7.2	230	8.5	***0.058***
5/22/92	7.6	40	***4.8***	0.033
7/6/92	6.6	140	8.6	0.050
8/3/92	7.3	60	8.4	0.039
6/11/93	6.8	60	8.8	0.047
6/29/93	7.6	20	8.4	***0.073***

(Values in italics and bolded represent a violation of State standards.)
Source: 1989-1993 NHDES Ambient Water Quality Monitoring Results

In 1991 sampling was concentrated further west in the watershed. The only two sites sampled from the previous year were Boston Post Road and the mouth of the River, SHG-2. On all three sampling dates, both sites violated the 88 E. coli/100 ml standard for bathing areas and exceeded the 0.05 level of concern for nutrients; however, the site at the mouth of the river did not violate the E. coli standard for nonbathing areas of 406 E. coli/100 ml. Upstream, the nonbathing site E. coli standard was violated in Milford at the Route 13 bridge twice and at the green bridge once while nutrient levels at these sites were below the level of concern. The level of concern for nutrients was again exceeded at the Route 31 bridge site near the Wilton/Greenville town line.

The 1993 sampling period concentrated on the stretch of the River between the Wilton Road bridge in west Milford and the Route 13 bridge in Milford. A single sample was collected at nine sites on August 5. The dissolved oxygen standard was violated at the site below the Wilton Road bridge in Milford, behind the gas station in Milford and at the mouth of Great Brook in town. These same three sites violated the single sample standard of 88 E. coli/100 ml while the site at the mouth of Great Brook far exceeded the 406 E. coli/100 ml standard with a count of 4,800 E. coli/100 ml. Nutrient analyses of the samples were not conducted. Further investigation in 1994 into the source of the problem at the mouth of Great Brook attributed the high E. coli counts to natural sources, namely a high concentration of ducks and pigeons underneath a road bridge.

In addition to the sampling conducted by the DES, the Merrimack River Watershed Council (MRWC) has employed volunteers to monitor water quality in the Souhegan River for the past 4 years. Eleven sites on the River from the mouth to above the mill pond in Greenville. Seven of the sites were selected to correspond with the sites that DES monitors to facilitate a comparison of the volunteer results with professional results. Of the 53 samples collected and analyzed during the 1992 sampling season, only three exceeded the instantaneous water quality standard of 406 E. coli/100 ml., the first Route 31 crossing below Greenville, the swimming hole at Tuttle's and below the Route 122 bridge in Amherst. The geometric seasonal mean of 126 E. coli/100 ml was exceeded at four of the sites, the first Route 31 crossing below Greenville, the green bridge in Milford, the pedestrian bridge in Milford and the Route 122 bridge in Amherst. Eight of the eleven sites exceeded the instantaneous standard of 88 E. coli/100 ml for designated beach areas at least once during the sampling period. The three sites which did not exceed the standard were all located in Merrimack, Turkey Hill Bridge, Wildcat Falls and the mouth of the River.

The same eleven sites were sampled by volunteers eight times in 1993. Of the sixty samples collected and analyzed, only two violated the 406 E. coli/100 ml, below the Route 122 bridge in Milford and at the mouth of the River in Merrimack, and none of the sites exceeded the geometric seasonal mean of 126 E. Coli/100 ml. Five of the sites regularly exceeded the 88 E. coli/100 ml standard for designated beach areas, two of which are known contact recreation areas. The swimming areas at Boston Post Road in Amherst and above the Turkey Hill Bridge in Merrimack, exceeded the instantaneous standard six and seven times respectively, and both exceeded the seasonal geometric mean of 47 E. coli/100 ml for a designated beach area.

During the 1994 sampling season, the sites were sampled nine times on a bi-weekly basis beginning in June and ending in September. A total of 82 samples were collected at the eleven fixed sites with two additional samples collected from the Souhegan below the Wilton downtown and two samples from Stony Brook above the dam in downtown. Of the 82 samples, 43 exceeded the 88 E. coli/100 ml instantaneous standard for designated beach areas and eight exceeded the geometric mean of 47 E. coli/100 ml. Nine of the 43 samples exceeded the 406 E coli/100 ml instantaneous standard for nonbeach areas with three sites exceeding the geometric mean of 126 E. coli/100 ml. Greater than 50 percent of the samples exceeded the instantaneous standard of 88 at two sites, off Route 123 above the Mill Pond in Greenville and the green bridge in Milford. Three of the sites exceeded the instantaneous standard of 88 E. coli/100 ml 100 percent of the time and the geometric mean for both nonbeach and beach areas, the pedestrian bridge in Milford, below the Route 122 bridge in Milford and the swimming hole at Boston Post Road in Amherst.

Based on the information presented above, several areas of the Souhegan River do not meet state water quality standards. Of particular concern are the sites where contact recreational use is documented: the Horseshoe in Wilton, the canoe access below the NH 122 bridge in Milford, the swimming hole at the Boston Post Road bridge in Amherst and the swimming hole above the Turkey Hill Bridge in Merrimack. During 1994 the samples collected at the canoe access below the NH 122 bridge in Milford and the swimming hole at the Boston Post Road bridge in Amherst met neither the instantaneous standard of 88 E. coli/100 ml for designated beach areas for the entire sampling season nor the geometric means of 47 E coli/100 ml for designated beach areas or 126 E./coli for all other areas. The site immediately upstream at the pedestrian bridge in Milford also exceeded the geometric mean for nonbeach areas. These sites should be identified as priority areas of concern and the DES should be encouraged to investigate and determine the source of the problem. Additional investigations should be conducted at the Greenville site above the Mill Pond and the green bridge in Milford.

Fisheries Habitat

Fish species found in the Souhegan River are those indigenous to southern New Hampshire rivers and streams. The River is stocked annually with brown, rainbow and brook trout as there is little documented natural reproduction of these species. In addition, the Souhegan River is one of the most productive Atlantic salmon nurseries in the State.

The habitat requirements of the trout species are quite similar: clear, cold water; silt-free rocky bottom; well vegetated stream banks; 1:1 ratio of pools-to-riffles with areas of slow, deep water; abundant instream cover; relatively stable water flow, temperature regimes and stream banks; and a good supply of macroinvertebrates and insects. The requirements for juvenile salmon change with developmental stage: substrate preferences change from gravel to boulder-rubble; water depth requirements increase from 10-15 cm to over 30 cm; and average velocity requirements of 13.9 cm/s to 20.0 cm/s; however, temperature requirements remain constant with optimal growth occurring in streams with diurnal peaks of 22° to 25° C.

Trout are released into the River in the early spring when the water temperatures are low and flows are high. The optimal temperature range for trout is 7° C to 19° C. By June, temperatures in the River have already risen to the high end of the optimal range and get even higher as the summer progresses. Based on the information collected by the MRWC volunteers, temperatures in the Souhegan River generally exceed the optimal range for trout by mid-June west of Wilton. East of Wilton, River temperatures are three to six degrees lower than in western locations and remain within the optimal range throughout much of the summer.

While the analysis and recommendations for the specific requirements of individual fish species, such as pH, water velocity, substrate and instream cover, are best left to the fisheries biologists, there are a number of actions that can be taken at the local level to maintain or enhance other aspects of fisheries habitat. Water temperature depends in part on tree cover and shading. Maintaining vegetation along the stream corridor can lower water temperatures by decreasing the thermal impacts associated with direct sunlight. In addition, discharges of noncontact cooling waters from industrial processes can also impact temperature. Therefore, if a site plan proposal is received which would involve a discharge to the Souhegan River or one of its tributaries the review should include an assessment of the thermal impacts to the receiving water. Also, the temperature of stormwater discharges from paved areas may be higher than those of the receiving water which could exacerbate the problem during the summer when the system is most stressed. Utilizing surface stormwater management measures, which allow the water to infiltrate into the ground rather than be directly discharged into the receiving water via a pipe, can decrease the thermal impacts from runoff.

Despite the fact that the Souhegan River is highly regulated for flood control, flows in the River and its tributaries are characterized by extreme fluctuations. Low flows and increased temperatures combine during the summer to place additional stress on fish. Aside from habitat requirements, the major issues concerning flow at the local level are withdrawals and dams/hydro facilities. Changes in water flow can have a significant impact on fisheries habitats. Any proposals for additional major water withdrawals from the Souhegan River should address the impact on flows and existing downstream uses. Of particular concern is maintaining the capability of the River to handle municipal wastewater discharges. Changes in water chemistry arising from changes in flow could also adversely impact fisheries habitats. The only avenue presently available to communities to establish minimum instream flow levels is designation of the River as significant under the NH Rivers Management and Protection Program, (RSA 483). The statute requires the establishment of minimum instream flows for all rivers designated under the program.

Erosion and the resulting sedimentation from construction sites, timber operations and other land based operations can also have a significant impact on fisheries habitats. Turbid waters can prevent sunlight from penetrating to lower levels inhibiting photosynthesis further depleting dissolved oxygen supplies. Suspended

soil particles can also damage fish gills and make feeding difficult since prey cannot be easily seen. Once the soil particles settle out of the water, accumulated sediments can change the substrate and destroy fish habitats, along with eliminating important food sources such as macroinvertebrates. Adequate planning, maintenance and enforcement of erosion and sediment control measures can decrease the impacts of sedimentation on fisheries. By requiring setbacks for activities adjacent to surface waters, maintaining vegetated buffers, and employing erosion control measures the impacts of development on fisheries habitats can be minimized. Inspection and maintenance are key to the continued effectiveness of erosion and sediment control measures and additional emphasis needs to be placed on local enforcement of erosion and sediment control plans.

Water Flows

Water flow in the Souhegan River fluctuates greatly throughout the year, from a high of 818 cfs in April to a low of 39 cfs in September. These natural fluctuations have created problems for river users through the years: flooding in the spring, lack of water for irrigation and power production in the summer, insufficient flows to handle waste assimilation, variations in recreational use and diminished and stressed habitats for fish and wildlife. Numerous standards have been developed for each of these uses and a host of others. While it is beyond the scope of this document to assess the flow requirements for each individual use, an evaluation of a few of the major uses will be conducted.

The Souhegan River provided water for power and manufacturing to the early mills. Now those mills produce electricity at five locations on the River. All of the dams are classified as run-of-the-river; however, each dam ponds water to varying degrees. The dams are all subject to the seasonal variations in flow and one hydro facility ceases to operate in the summer due to low flows. The concern with the dams should focus on any proposed increases in the height of the dam and the impoundment behind the dam, and licensing renewals. These activities will have the greatest potential to influence water flow as well as recreation, wildlife and fisheries habitats.

Water withdrawals for industrial or irrigation purposes can also have a significant impact on Souhegan River flows. Where River water was once utilized to irrigate crops it now is used to irrigate golf courses and recreational fields. While the impact of an individual withdrawal for agricultural irrigation may be minor, the cumulative impact of a number of withdrawals may be significant. Industrial withdrawals from the River have declined due initially to the loss of the mills and more recently changes in technology which have reduced demand. The Department of Environmental Services requires facilities that withdraw 20,000 gpd or more to register with the Water Management Bureau. All registered withdrawals are required to report their water use on a quarterly basis. This program provides DES with information that can be used in managing the resource for withdrawals, discharges and other uses. All water withdrawals within the watershed that meet the 20,000 gpd criteria should register with the WMB. Any proposal received at the local level which includes a withdrawal meeting this criteria should be required to register with the WMB as a condition of the approval. In addition, the Planning Board may want to have proposals for withdrawals reviewed by the WMB to assess potential impact on existing withdrawals and discharges to the River, particularly regarding the maintenance of water quality .

The major water withdrawals on the Souhegan River are for irrigation. These withdrawals are important with regard to fisheries habitats since the largest withdrawals are during the summer when the stress on fish is greatest due to low flows, temperature and dissolved oxygen levels. Evaluations of withdrawal proposals should contain information on the potential impact on fish within the River system.

The principal recreation use associated with flow in the Souhegan River is boating. Canoeing and kayaking have historically been limited to the spring and other periods when flows are adequate. Given the natural flow characteristics of the River, this is unlikely to change. Two activities with potential impact on recreational use

are dams and withdrawals. Currently there are no known plans to construct additional dams on the River or to renovate existing facilities that would have a significant impact on flows; however, any alterations to existing facilities should consider the impact on recreation. In general, a water withdrawal that would have an effect on the historical pattern of canoeing and kayaking on the River would have to be extremely large since it would occur during the season when flows are highest.

Two wastewater treatment plants, Milford and Greenville, currently discharge into the Souhegan River. Certain minimum base flows must be maintained to provide for the adequate assimilation of the wastewater discharged into the River. To evaluate the impacts of wastewater discharges under differing conditions, the NH Department of Environmental Services (DES) conducts waste load allocation studies to determine the parameters for the discharge based on water quality standards. In 1990, the DES conducted a wasteload allocation study for the Souhegan River at the request of the Town of Amherst which had been considering the development of a groundwater wastewater treatment facility to serve an industrially zoned area of the community. The purpose of the study was to determine the parameters of the proposed discharge and to assess the impact of the additional discharge on the existing Milford discharge. Waste load allocation studies are conducted based on what is considered the worst case scenario, 7Q10 flows -- the seven day low flow which occurs on the average of once every ten years. Based on the results of the modeling, the DES provided options for the Amherst and Milford discharges. The communities are currently discussing the options. In addition, wastewater treatment facility permits are renewed every three years. The watershed communities should be aware of this process and bring any water quality issues to the attention of the DES. The importance of the ability of the Souhegan to safely accommodate increased wasteloads cannot be understated as it is directly linked to the growth of the region's economy as well as its population and the overall quality of life for watershed residents, both animals and humans.

ZONING AND REGULATION ANALYSIS

All twelve communities in the watershed have an adopted zoning ordinance in place. An overview of the zoning provisions within each community is provided in Table V-2 and each district is discussed in more detail in the Zoning section and within other sections dealing with the specific area of concern. Minimum lot size within the residential, commercial and industrial districts varies greatly and depends on the availability of municipal water and sewer, soil development potentials for septic systems and elevation. Seven of the twelve communities have adopted some level of local wetland protection while the Ashby and Ashburnham Conservation Commissions administer the Massachusetts Wetlands Protection Act (MA WPA). Eight communities have adopted floodplain protection ordinances. Lyndeborough and Mont Vernon have elected not to adopt floodplain ordinances because of the low levels and the location of their respective floodplains as mapped by FEMA. The four communities that have adopted aquifer protection ordinances encompass the watershed's most significant deposits of stratified drift and all rely in total or in part on groundwater for their municipal water supplies. Only New Ipswich has adopted development restrictions on steep slopes that apply to the entire Town. Wilton's slope provisions only apply in the watershed district. Three communities have adopted local shoreland protection provisions that provide greater protection than the NH Shoreland Protection Act and shorelines are included in the scope of MA WPA and are administered by the Conservation Commissions in Ashby and Ashburnham.

All twelve towns have adopted subdivision regulations and all of the NH towns have adopted site plan review regulations. The subdivision and site plan regulations establish the administrative procedures by which the Board will review proposals; define the information required to evaluate the overall impact of the proposal on the community; and establish standards regulating such areas as utilities, road design, buffers and landscaping, erosion and sedimentation control, stormwater management, parking and open space. Nine of the communities permit open space developments to allow alternate designs that would preserve open space. The

TABLE V-2
SOUHEGAN RIVER WATERSHED
COMMUNITY ZONING ORDINANCES

	ZONING DISTRICTS								
Municipality	*Residential*	*Commercial*	*Industrial*	*Office Park*	*Wetland*	*Floodplain*	*Aquifer*	*Steep Slope*	*Shoreland Protection*
Amherst	yes 2 ac.	yes 1 ac.	yes 1 ac.	yes 1 ac.	yes	yes	yes		yes
Ashburnham, MA	yes 60,000 sq. ft.				yes State	yes			yes State
Ashby, MA	yes 80,000 sq. ft.				yes State				yes State
Greenfield	yes 2 or 4 ac.		yes 2 ac.		yes	yes			
Greenville	yes 1 or 2 ac.	yes 0.5 ac.	yes 5 ac.			yes			
Lyndeborough	yes 2, 5 or 10 ac.		yes 2 ac.		yes				
Merrimack	yes variable	yes 20,000 sq.ft.	yes not defined		yes	yes	yes		yes
Milford	yes variable	yes variable	yes variable		yes	yes	yes		yes
Mont Vernon	yes 2&5 ac.	yes 2&5 ac.			yes				
New Ipswich	yes 1, 2 or 3 ac.				yes	yes		yes	
Temple	**yes 2, 3 or 5 ac.**								
Wilton	**yes variable**	**yes variable**	**yes 2 ac.**	**yes 5 ac.**	**yes**	**yes**	**yes**		

Variable: lot size varies based on presence of water and/or sewer service, or soil type for subsurface systems
State: provisions covered by the Massachusetts Wetlands Protection Act

regulations generally establish minimum tract sizes for open space developments, minimum lot sizes within the development and the percent of the tract that must remain as open space. By minimizing the developed area, open space design regulations can have a positive impact on the surrounding environment.

Excavation is another land use with a potential negative impact on surface and ground waters. Nine of the communities have adopted local excavation regulations to implement the provisions of NH RSA 155-E Local Regulation of Excavations. The regulations generally include provisions to protect surface and ground waters from the potential negative impacts of excavations such as requirements for erosion and sediment control measures, restrictions on the depth of excavations based on the seasonal high water table and requirements for reclamation.

Six communities require erosion control plans as part of both the subdivision and site plan regulations, two require them for just site plans, two for just subdivisions while two communities do not require erosion control plans at all. Likewise, eight communities require stormwater management plans in both the subdivision and

site plan regulations while two require plans for just subdivisions, one for just site plans and one town does not require stormwater management plans at all. Erosion and sedimentation control plans indicate what measures will be utilized on site to control erosion. Stormwater management plans provide information on how surface runoff will be managed on site to minimize soil erosion and allow for infiltration. Erosion and sediment control plans and stormwater management plans can have a significant impact on surface water quality. By minimizing the impact of erosion and sedimentation surface water quality and habitats are protected. On site infiltration of stormwater provides the opportunity for nutrients, sediments and other pollutants to be filtered from the water and bound up into the soil, thus decreasing the pollutants that reach the surface waters.

The above analyses are based on a review of the communities zoning ordinances, subdivision regulations and site plan regulations. While a community's regulations may contain no reference to erosion and sedimentcontrol plans, the plans may be required on a case specific basis. A synopsis of the information is contained in Table V-3.

TABLE V-3
SOUHEGAN RIVER WATERSHED
COMMUNITY LAND USE REGULATIONS

	REGULATIONS					
Municipality	*Subdivision Regulations*	*Site Plan Regulations*	*Open Space Development*	*Excavation Regulations*	*Erosion Control*	*Stormwater Management*
Amherst	yes	yes	yes	yes		yes
Ashburnham, MA	yes				yes**	yes**
Ashby, MA	yes				yes**	yes**
Greenfield	yes	yes	yes	yes	yes	yes
Greenville	yes	yes	yes			
Lyndeborough	yes	yes		yes	yes	yes
Merrimack	yes	yes	yes	yes	yes	yes
Milford	yes	yes	yes	yes	yes	yes
Mont Vernon	yes	yes	yes	yes	yes*	yes*
New Ipswich	yes	yes	yes	yes	yes	yes
Temple	yes	yes	yes	yes	yes*	yes
Wilton	yes	yes	yes	yes	yes	yes

yes* = required only by the site plan review regulations
yes** = required only by the subdivision regulations

BEST MANAGEMENT PRACTICES (BMPs)

With regard to this study, best management practices will be defined as structural and nonstructural measures that reduce the impact of an activity on stormwater runoff, erosion and water quality. The previous section identified those communities whose regulations require stormwater management and erosion and sediment control plans. These plans generally include an analysis of the increase in runoff due to the proposed development, the methods to be employed for long-term and short-term stormwater management and the erosion and sediment control measures to be utilized on site. Agriculture, forestry and land development are the three major areas where BMPs are applied.

Agricultural BMPs include numerous activities such as maintaining vegetated buffer strips adjacent to surface waters, testing the soil to determine the appropriate fertilizer applications, timing of fertilizer and pesticide applications to maximize plant uptake and minimize runoff into surface and ground waters, minimizing soil exposure to the elements through mulching and planting of winter crops and installing systems to manage manure and other wastes. The dominant agricultural land use in the Souhegan watershed is untilled pasture and hayfields. Because a vegetative cover is constantly maintained in these operations, the potential for erosion is minimal and BMPs focus on techniques for spreading manure - application rates, setbacks from surface waters and the timing of applications. Orchards represent the second largest agricultural use in the watershed. The major concern with orchards is the application of pesticides. Pesticides should be applied at the lowest rates possible and timed such that the impact to surface water, groundwater and surrounding vegetation is minimized. Tilled cropland within the watershed is predominantly corn for feed and small truck crops. Erosion is a concern in addition to the BMPs already discussed. Contour plantings, minimizing soil exposure and maintaining vegetated buffer strips can all decrease the potential negative impacts of erosion on surface waters. The Natural Resources Conservation Service, the County Conservation Districts and the UNH Cooperative Extension Service are the three agencies most active in agricultural activities and BMPs. Communities should encourage agricultural operations to cooperate with these agencies and to utilize BMPs to protect the water resources of the watershed. During the last 30 years great strides have been made in decreasing the impact of agricultural activities on water quality through education and the use of BMPs.

Before any timber operation can occur, the landowner must file an intent to cut form with the municipality in which the land is located. This form provides notice of all timber harvesting that takes place within a community. Forestry BMPs include such things as timing of cuts, minimizing road construction and wetland crossings, maintaining vegetated buffers along surface waters and grading and reseeding landings. A number of agencies within the State are involved with timber harvesting, the NH Department of Resources and Economic Development Division of Forests and Lands, the UNH Cooperative Extension Service, the County Conservation Districts and County Foresters, and the NH Timberland Owners Association. Education on timber harvesting laws and BMPs has been extensive and includes such publications as Best Management Practices for Controlling Soil Erosion on Timber Harvesting Operations in New Hampshire and the New Hampshire Municipal Officials' Guide to Timber Harvesting Laws which have both been distributed to each municipality in the State, to landowners, foresters and timber operators. The major concern with timber harvesting operations is erosion and sedimentation; however, the impact of these operations can be minimized through the use of BMPs.

Land development activities have the greatest potential to negatively impact surface and ground water in the Souhegan River watershed. As with agriculture and forestry, BMPs can be utilized to decrease the impacts of development. Numerous BMPs exist for land development some of which are the same as for other land uses such as minimizing soil exposure through mulching and seeding, maintaining vegetated buffer strips adjacent to surface waters and minimizing wetland crossings. Other BMPs include open drainage designs, riprap, detention/retention basins, sediment basins, infiltration trenches, silt fences and hay bale barriers. The Rockingham County Conservation District with the assistance of the NH DES published the Stormwater Management and Erosion and Sediment Control Handbook for Urban and Developing Areas in New Hampshire in August of 1992. The Handbook provides information on the design and appropriate use of BMPs. Every community in the State received a copy of the Handbook. As discussed in the previous section, ten communities require erosion and sediment control information for development proposals and eleven communities require information on stormwater runoff and drainage. Many of the NH communities reference the Handbook as a source for BMP design standards.

Planning Boards and Conservation Commissions are most involved with land development activities and local knowledge of BMPs is good throughout the watershed, though it varies based on the composition of the board and the tenure of its members. For major proposals, the erosion and sediment control plans and drainage

designs are reviewed by the municipality's engineering staff or by the local board's consulting engineer. Boards can also request the assistance of the Natural Resources Conservation Service in reviewing drainage and erosion control plans. The Wetlands Board reviews drainage and erosion control for all applications it receives; while the DES Water Supply and Pollution Control Division (WSPCD) reviews drainage and erosion control under RSA 485-A:17 Alteration of Terrain for all projects which disturb 100,000 square feet or greater or 50,000 square feet or greater in the protected shoreland. Smaller projects which require a wetland permit are reviewed by the WSPCD representative to the Wetlands Board.

While local understanding and review procedures of BMPs may be adequate, maintenance of temporary and permanent structures and enforcement are inadequate. Regular inspections are key to the effectiveness of most BMPs. Given the size and the staffing levels of most of the communities in the watershed and the existing responsibilities of the enforcement officials, inspecting BMPs is a low priority compared to building codes, road standards and health codes. Additionally, enforcement of those projects which require WSPCD or Wetland Board permits is also difficult based on staffing levels and the need for almost immediate inspection to confirm a violation.

There are a number of options that could provide some relief to this situation. Provide additional training to zoning, building and code enforcement officials on the importance of BMPs to water quality and inspection procedures. Since many construction projects may not require Planning Board and/or Conservation Commission review, the Building Inspector needs to be able to determine when erosion control measures may be necessary and require the developer to install the appropriate measures. Planning Board and Conservation Commission members can also be enlisted to assist with the inspections of BMPs. While the engineering involved with designing BMPs may be complex, it is fairly easy to determine if a BMP is functioning properly. Sometimes it is as simple as noticing that a silt fence has fallen down and needs to be restaked or that a sediment basin is full and needs to be cleaned. In most instances the BMPs employed on a site are not that complicated. Planning Board and Conservation Commission members could be assigned specific cases and follow them through the development process. If an inspection is conducted and a problem detected it could be reported to the appropriate official for enforcement. Communities should also maintain an inventory of the permanent drainage and erosion control structures in the Town and develop a regular inspection program to insure proper maintenance.

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SECTION VI:

GOALS, OBJECTIVES AND RECOMMENDATIONS

SECTION VI: GOALS, OBJECTIVES AND RECOMMENDATIONS

After reviewing the information compiled on the Souhegan River Watershed, the advisory committee defined a goal and a series of objectives to guide future management of the watershed resources such that the multiple use aspects of the River are preserved.

GOAL

A wisely managed watershed that protects significant resources while balancing the diverse physical, natural, cultural, recreational, economic and scenic resources with existing and future development.

OBJECTIVES

1. Restore and protect surface water and groundwater quality and quantity within the watershed.

2. Protect environmentally sensitive areas within the watershed such as wetlands, aquifers, wildlife/plant habitats, shorelines and steep slopes.

3. Develop and implement land use regulations that promote responsible land use and development within the watershed.

4. Encourage businesses within the watershed to utilize technologies to decrease water consumption, reduce waste disposal and properly store hazardous materials utilized on site.

5. Increase public access to and use of the Souhegan River in appropriate areas.

6. Promote public awareness of the watershed concept and the issues relative to the Souhegan River watershed.

7. Develop a greenbelt along the Souhegan River shoreline to retain the existing character and to protect it from future development.

RECOMMENDATIONS

Previous sections of the study have examined and analyzed the physical and natural characteristics of the Souhegan River watershed and the impacts of human uses on these resources. The issues and concerns identified will need to be addressed in order to achieve a balance between the many River uses and users. Maintaining balance is essential to the continuation of the Souhegan as a multiple use river. Achieving this balance will require actions at all levels of government, local state and federal, as well as at the household and individual levels. The recommendations contained in this section are designed to address the goal and objectives.

Local Land Use Regulations

Develop and adopt local shoreland protection regulations in the watershed communities of Greenfield, Greenville, Lyndeborough, Mont Vernon, New Ipswich, Temple and Wilton. At a minimum, the regulations should include the provisions of the Comprehensive Shoreland Protection Act (RSA 483-B, effective July 1, 1994) which applies to all water bodies contained on the official list of public waters published by the Department of Environmental Services and fourth order or higher streams. With regard to streams in the corridor, the Act affects only the Souhegan River and one of its tributaries, Stony Brook in Wilton. The statute also grants communities the

authority to enact shoreland protection regulations that are more stringent than the Act. The shoreland protection regulations developed at the local level should be broadened in scope to include the major tributaries to the Souhegan River. The Office of State Planning has developed a model Shoreland Protection Ordinance based on the Act to assist communities in drafting local ordinances.

2. Develop and adopt wetland protection regulations in Greenville and Temple. Wetland systems protect water quality by filtering sediments, nutrients and other chemicals from surface runoff, and provide important wildlife habitat.

3. Develop and adopt minimum lot size requirements for developments in unsewered areas based on the capability of the soil for onsite wastewater treatment. An ad-hoc committee of experts studied onsite wastewater treatment in New Hampshire and recommended a soil based lot size system. In 1991 the Committee published a technical report, Environmental Planning for Onsite Wastewater Treatment in New Hampshire, and a model regulation for soil based lot sizes. The standards developed for soil based lot sizes have been incorporated into the Comprehensive Shoreland Protection Act.

4. Develop and adopt regulations to restrict development on slopes greater than 25 percent in the watershed communities. New Ipswich is the only Town in the watershed that regulates development on steep slopes. Limiting development on steep slopes decreases the potential impacts of soil erosion on surface waters and is particularly important along the riverbank. The natural vegetation should be retained in steep slope areas and unvegetated areas should be replanted to stabilize the soil and inhibit erosion.

5. Amend the subdivision regulations in Mont Vernon to include a requirement for erosion and sediment control and stormwater management plans for all proposals. These plans are important for the prevention of NPS impact on surface waters.

6. Amend the Temple subdivision regulations to require erosion and sediment control plans. These plans are important to minimize the impact of NPSs on surface waters.

7. Amend the subdivision and site plan review regulations in the watershed communities to require information on the presence of threatened and endangered species and habitats on the site prior to approval. This information will allow the planning board to plan for habitat protection during the development review process.

8 Consult the NH DES Water Resources Division on development proposals that would involve a surface water withdrawal and request their assessment of the proposed withdrawal's impact on the quality and quantity of water in the Souhegan River.

9 Request conservation and pedestrian easements along the Souhegan River during the site plan and subdivision review processes in all corridor communities. These areas can be used to meet open space and recreation requirements. RSA 674:36 Subdivision Regulations and RSA 674:44 Site Plan Review Regulations authorize communities to include open space and recreation land criteria in the regulations and to consider these criteria when reviewing development proposals.

Enforcement

Inform and educate enforcement officials on the local, state and federal regulations that pertain to actions within the Souhegan River watershed to assure proper understanding of the regulations and the rationale behind them.

2. Provide qualified inspectors and adequate inspection programs to ensure adherence to the community's regulations, conformance with the conditions of the development approval and proper installation and maintenance of erosion and sedimentation control measures.

3. Assign individual members of the Planning Board and Conservation Commission to regularly monitor developments throughout the construction phase. This informal inspection process will identify potential problems and allow the town to deal with the situation before it becomes a major violation.

4. Report any violations of local, state or federal regulations to the appropriate agency. To facilitate citizen reporting of violations, the Conservation Commissions within the watershed should work jointly to develop and distribute informational brochures and fact sheets describing the regulations and identifying the appropriate contact for reporting a violation. The Department of Environmental Services has a series of fact sheets available that describe state regulations.

5. Consider jointly hiring a person to inspect BMPs, particularly for land development and timber harvesting, for the watershed communities. Sharing an inspector would greatly reduce the cost to each municipality.

Local Actions

1. Encourage Amherst and Milford to work out an agreement to connect the 101A industrial area to the Milford sewer system. The Wasteload Allocation Study recommended this as one of the alternatives to constructing a groundwater system on the industrial site.

2. Consider nominating the Souhegan River for designation under the NH Rivers Management and Protection Act. Designation into the program is the only avenue currently available for establishing a minimum instream flow for the River. The support of the communities adjacent to the River is essential to the success of the designation. Depending on the nomination category, the program establishes protection measures related to dams, hydro facilities, channel alterations, water quality, instream flows, interbasin transfers, siting of solid and hazardous waste facilities and recreational use. The information required in the nomination forms is contained in this document.

3 Wilton should pursue a Phase II study for the Wellhead Protection Program. The initial work was conducted by EPA as a pilot project. The second phase involves the identification of potential contaminant sources and developing a management plan for the wellhead area.

4. Milford should continue to seek an intermunicipal agreement with the Town of Amherst to protect the drinking water supply.

5. Discuss the results of the MRWC's volunteer water quality monitoring program with the DES. Specific attention should be drawn to those sites where repeated violations of the water quality standards have occurred such as the Greenville site off NH Route 123 above the Mill Pond, the Horseshoe in Wilton, below the green bridge in Milford, below the NH Route 122 bridge in

Milford, the area of the swinging bridge in Milford, the Boston Post Road bridge in Amherst and the Turkey Hill Road bridge in Merrimack.

6. Develop and distribute informational materials on reducing household nonpoint pollution sources (NPS). Households are a major source of NPS from fertilizers and pesticides applied to lawns to malfunctioning septic systems and improper storage and disposal of household hazardous wastes. Education is key to reducing household NPS.

Public Access

Acquire and develop two formal canoe/kayak launches in each of the corridor communities. Public ownership of these areas will insure permanent public access. Two public access points in each community will allow users to plan for a variety of trip lengths and improve the potential for recreational boating on the River. Launches can be developed on existing publicly owned parcels where possible and/or parcels may be purchased or donated specifically for providing river access. In addition, improvements at the existing public launches in Merrimack, Amherst and Wilton could be made to eliminate/minimize any areas of erosion, to refine the parking areas, and to identify the launching area along the bank.

2. Develop a continuous trail system along the Souhegan River. While each community has its own system of local trails, there has been only a limited effort at coordinating an interconnected system along the River.

   Acquire conservation and pedestrian easements, by donation or purchase, across individual properties for the trail corridor.

4. Develop parking areas at strategic locations to provide parking for public access areas and investigate opportunities for developing shared parking programs with existing businesses/ agencies in areas where it is appropriate.

5. Erect signs at existing public accesses and provide signs for future public access areas to identify their locations. Existing public access areas are inadequately marked and difficult to find. In addition, signs can be used to define the permitted uses and hours of operation.

6. Develop maps and brochures in each community and for the entire Souhegan River showing the location and the conditions of use for each public access point, the trail and shared parking areas, and significant natural and historic areas, and distribute the brochures at public offices and libraries.

Education

1. Conduct a series of meetings to present to the public and discuss the information contained in the Souhegan River Watershed Study.

2. Develop a Souhegan River watershed fact sheet containing highlights from the study and identifying ways that individuals can get involved, and distribute it throughout the watershed communities.

3. Conduct workshops on the NH Shoreland Protection Act to acquaint Planning Boards, Conservation Commissions and riparian land owners with the provisions of the Act. The Act applies to all land within 250 feet of the Souhegan River, Stony Brook and lakes/ponds greater

than 10 acres in size. Many communities and landowners are not yet familiar with the provisions of the Act.

4 Involve the watershed community schools in Souhegan River activities to promote public awareness, to educate the students on the history of the River, its current conditions and potential threats, and to instill a connection to the River in the future leaders of the region. The schools should continue to participate in the on-going river water quality education programs sponsored by the New Hampshire Department of Fish and Game and initiate the use of comprehensive river related curriculum. Watershed education efforts should take place at all grade levels.

5 Sponsor River related events and competitions such as canoe trips, clean-up days and photography contests to promote conservation issues and recreation opportunities, and to further develop individual connections to the River.

6. Utilize the power of the press to promote the issues and activities surrounding the Souhegan River. Publicize all public meetings, clean-up days, access dedications, recreation events and volunteer activities.

Volunteer Activities

1. Continue to monitor water quality in the Souhegan River as part of the Merrimack River Watershed's volunteer monitoring network and examine the possibility of expanding the number of sites sampled to include additional locations on the mainstem and on the major tributaries. Through this program trained volunteer's collect water samples throughout the summer. The information obtained through the program is analyzed to pinpoint water quality problems and to identify potential sources.

2 Develop a greenway along the Souhegan River to protect the shoreline from future development, to link together key publicly owned pieces of land, to protect significant wildlife habitats and corridors, and to provide open space and public access.

3 Obtain parcel ownership information for the shoreline of the Souhegan River. This information will be useful in many areas such as trail planning, greenway development and information dissemination.

4. Utilize local service organizations to assist with river related activities such as clean-up days, trail construction and maintenance, and the production and distribution of brochures.

State Actions

Encourage the New Hampshire Department of Environmental Services (NH DES) to establish a regular biomonitoring program on the Souhegan River and its major tributaries. Biomonitoring can identify water quality problems that may not be identified through traditional chemical analyses.

2. Encourage the NH DES to identify the major swimming areas on the Souhegan as "designated bathing areas" which would be subject to the stricter water quality standard of 88 E. coli colonies per 100 ml.

3. Request that the NH DES establish additional annual state monitoring stations located further up in the watershed. The existing annually monitored station is located at the mouth of the River and is not representative of the conditions in the majority of the watershed.

4. Encourage the NH DES to increase enforcement of existing environmental regulations for erosion and sedimentation control, stormwater management, subsurface waste disposal, water quality and dredge and fill of wetlands. Stricter enforcement of these regulations will protect the water quality and the shorelands of the Souhegan River.

5. Encourage the NH DES to support volunteer water quality monitoring programs and to utilize the water quality information collected by the volunteers when assessing the water quality in the Souhegan River. The information collected by the volunteers can be used to identify problem areas that warrant further investigation by the Department.

6. Encourage the NH DES to take a cumulative look at existing conditions and water use on the Souhegan River when considering reauthorization of existing water discharge permits or issuing new permits, licensing of hydropower facilities and registration of water withdrawals.

7. Encourage the NH DES to work with businesses in the corridor to utilize systems and methods which protect surface and groundwater quality. This could include water conservation, source waste reduction and using less hazardous materials in their operations.

ORGANIZATIONAL INVOLVEMENT

Accomplishing the recommendations depends on the support and involvement of many organizations within each community. For example, municipal governments must not only support the general concept of developing a trail along the river but also be willing to commit funding, such as matching funds for land or easement purchases or purchasing signs to identify access areas. Other groups with a role in conserving the Souhegan River include: municipal planning boards and conservation commissions, private conservation and environmental organizations, regional planning commissions, county conservation districts and the Natural Resources Conservation Service.

Municipal Government

Municipal government in all of the watershed communities takes place at two levels. The Board of Selectmen as the governing body is responsible for the day-to-day operations of the Town. The local legislative body is the town meeting. The support of both groups is essential to the successful implementation of the recommendations. Since some of the recommendations requiring local action deal with the zoning ordinance and changes to the zoning ordinance must be voted on by the legislative body, it is essential for the voting population to understand the rationale behind any proposed changes and the benefits which will accrue to the Souhegan River and the other water resources in the community. This will require an extensive educational effort in all of the corridor communities. The support of the board of selectmen is important because of their responsibility to enforce municipal regulations. The success of any effort to protect the River corridor bears a direct relationship to the support and commitment of the municipal government.

Planning Board

As the municipal board responsible for drafting new zoning ordinances, amending existing regulations and administering the town's land use regulations, planning boards play a major role in protecting the Souhegan River and its watershed. While the board recommends changes to the zoning ordinance, they must ultimately

be approved by the local legislative body. The planning board's job is to demonstrate the need for and the benefits of the proposed change to the regulation. Changes to the subdivision and site plan review regulations, however, can be made by a majority vote of the planning board after a public hearing; a town meeting vote is not required. The planning board can also use non-regulatory action to protect the River such as recommending changes to proposed designs and negotiating with developers for conservation easements.

The planning board in each community must understand the importance of protecting the Souhegan River watershed. As the initiators of land use regulations, planning board support is imperative since many of the recommendations will require the board to propose amendments to existing regulations or to develop new regulations for managing development in the River corridor. Other recommendations rely on the board's use of non-regulatory actions to obtain conservation and pedestrian easements along the River. Planning board support is therefore key to the success of protecting the Souhegan River watershed. The watershed planning boards must be encouraged to use their regulatory and non-regulatory powers to pursue the objectives of this study.

Conservation Commission

Conservation commissions are another local body closely involved with conserving the Souhegan River watershed. New Hampshire municipality's have the authority to create conservation commissions under RSA 36-A. Specific responsibilities listed in the statute include: conducting an inventory of the municipality's natural resources; coordinating the activity of unofficial bodies organized for similar purposes; and maintaining an index of the municipality's natural and scenic resources. In addition, conservation commissions may do the following: recommend to the governing body a program for the protection, development and sound utilization of all the areas in the index; acquire in the name of the municipality by gift or purchase the right to conservation lands and be responsible for their management and control; and provide public information on conservation issues.

Given these responsibilities, conservation commissions have a major role in protecting the Souhegan River. Therefore, the conservation commission in each community should take a lead role in developing a greenway/trail system along the Souhegan River. The conservation commissions in conjunction with the municipal recreation departments or commissions should identify key parcels along the River for public access and investigate alternative funding schemes for purchase and site development. The commissions could also conduct landowner contacts for obtaining conservation and pedestrian easements along the River. In addition, the commissions could be responsible for providing general conservation information to the residents of the communities.

Regional Planning Commissions

The Nashua Regional Planning Commission and the Southwest Region Planning Commission serve as forums for intermunicipal issues and regional policy such as those surrounding the Souhegan River. In addition to addressing regional issues, the Commissions provide technical assistance to the individual member communities in many areas including master planning, revising zoning, subdivision and site plan review regulations, natural resource planning, transportation planning and protecting historic resources. Because of this the RPCs are the appropriate forum for discussing issues affecting the localities and the region.

The RPCs are committed to assisting the communities in protecting the Souhegan River watershed. As regional agencies, the NRPC and SRPC have a great deal of information about the communities within their regions. This document, for instance, is an example of the resources available to the RPCs and how the information can be used to evaluate the impacts of local actions. With this information, the RPCs can assist the communities in developing consistent regulations and methods to achieve the goal of protecting the

watershed. In addition, RPC staff can assist the communities with applications for funding, drafting designation forms and making landowner contacts.

Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) can provide the communities with valuable information on soil and soil potentials. The NRCS can assist the communities in developing setback and buffer requirements based on soil types; in evaluating wetlands and wetland impacts; in evaluating erosion problems; and in providing general information on erosion and sediment control. In addition, NRCS staff can provide speakers for workshops, help individual landowners with site specific questions, and assist local land use boards with project reviews.

Souhegan Watershed Association

The Souhegan Watershed Association (SWA) is a newly formed group whose focus is on protecting the resources of the Souhegan River and its watershed. The SWA can assist with and take a lead role in the implementation of many of the recommendations of the Souhegan River Watershed Study. The SWA should assume a leadership role in increasing public awareness of the Souhegan River.

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APPENDIX A:

THREATENED AND ENDANGERED SPECIES RANKING SYSTEM

THREATENED AND ENDANGERED SPECIES

THE RANKING SYSTEM DEVELOPED BY THE NATURE CONSERVANCY AND USED BY AL STATE NATURAL HERITAGE PROGRAMS FOR "ELEMENTS" OF NATURAL DIVERSITY (RARE SPECIES AND EXEMPLARY NATURAL COMMUNITIES.).

Each element is assigned a single global rank by specialists under the guidance of the national Science Department of The Nature Conservancy. State ranks within each state, in which the element occurs, are assigned by the State Heritage Program and will vary from state to state.

GLOBAL ELEMENT RANKS:

- G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor of its biology making it especially vulnerable to extinction. [Critically endangered throughout range.]
- G2 = Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of other factors demonstrably making it very vulnerable to extinction throughout its range. [Endangered throughout range.]
- G3 Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single state, a physiographic region) or because of other factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100. [Threatened throughout range].
- G4 = Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- G5 = Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- GA = Accidental in North America (not part of the established biota, usually a species of bird).
- GE = An exotic species established in North America (e.g., Japanese Honeysuckle).
- GH = Of historical occurrence throughout its range, i.e. formerly part of the established biota, with the expectation that it may be rediscovered (e.g., Ivory-billed Woodpecker).

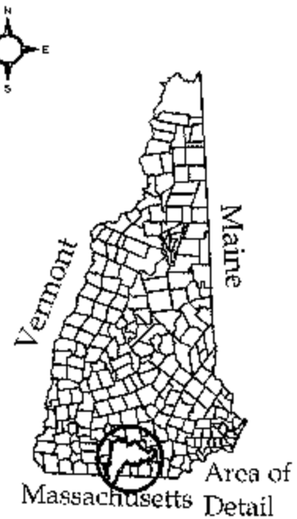
The New Hampshire Natural Heritage Inventory does not inventory GA or GE species.

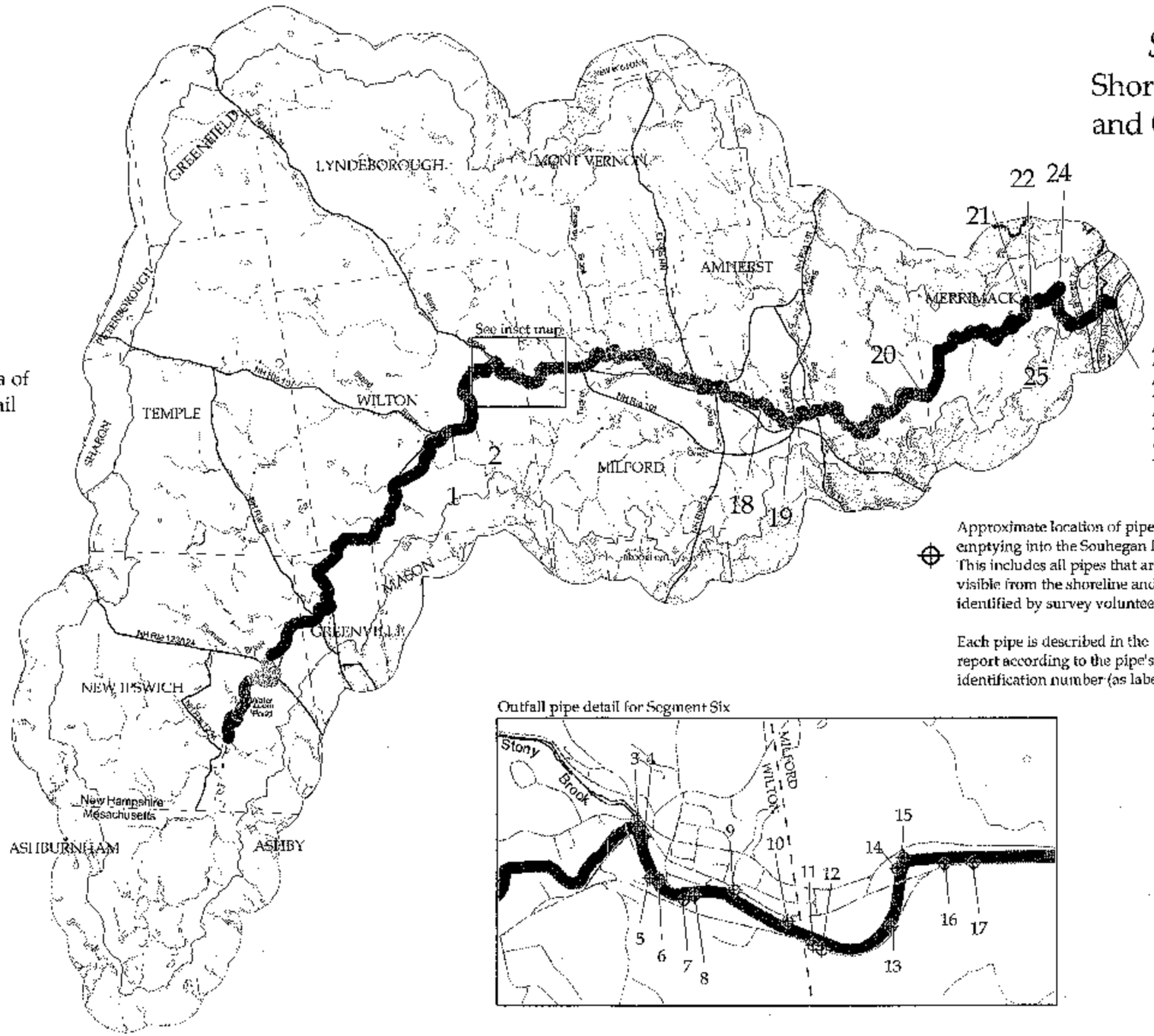
STATE ELEMENT RANKS:

- S1 = Critically imperiled in state because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor of its biology making it especially vulnerable to extirpation from the state. [Critically endangered in state.]
- S2 = Imperiled in state because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of other factors demonstrably making it very vulnerable to extirpation from the State. [Endangered in state.]
- S3 = Rare in state (on the order of 20+ occurrences). [Threatened in state].
- S4 = Apparently secure in state.
- S5 = Demonstrably secure in state.
- SA = Accidental in state, including species which only sporadically breed in state.
- SE = An exotic species established in state; may be native elsewhere in North America (e.g., house finch).
- SH = Of historical occurrence in the state with the expectation that it may be rediscovered.
- SU = Possibly in peril in state but status uncertain; need more information.
- SX = Apparently extirpated from state.

The New Hampshire Natural Inventory primarily inventories elements in the S1 and S2 categories plus several selected elements ranked S3.

Souhegan River
Shoreline Survey Segments and Outfall Pipe Locations





Approximate location of pipes emptying into the Souhegan River. This includes all pipes that are visible from the shoreline and were identified by survey volunteers.

Each pipe is described in the report according to the pipe's identification number (as labeled).

Location of segments surveyed by volunteers

- Segment One
- Segment Two
- Segment Three
- Segment Four
- Segment Five
- Segment Six
- Segment Seven
- Segment Eight
- Segment Nine
- Segment Ten

Outfall pipe detail for Segment Six

Map prepared by NRPC
Printed December, 1999
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1999

SOUHEGAN RIVER SHORELINE SURVEY

Table of Contents

Shoreline Survey Crew:

George May, Curt Schnare, Sam Mathews, Nat Ober, Don Bartlett, Bob Boynton, Karen Simms, Tom Quarles, John Vogl, Steve Campbell, Moira Gagnon, Gary Gagne, Ernie Thibault, Anne Krantz, Rich Hart, and the rest of the canoeists from Amherst.

Introduction to the Souhegan Stream Bank Survey

In 1998, the Souhegan Watershed Association (SWA) received a Department of Environmental Services Non-Point Source Pollution grant to conduct a stream bank survey of the Souhegan River. The SWA, which works to protect and improve the river for multiple uses, enlisted volunteer help from its members and local conservation commissions, and received technical assistance from the Nashua Regional Planning Commission (NRPC) and the Merrimack River Watershed Council (MRWC) to conduct this survey. The goal was to provide a snapshot of the river's vitality in 1999, and use this as baseline data to identify areas that will need future attention and monitoring as well as to prepare for future surveys.

The MRWC provided the survey instrument and conducted a training session for volunteers. To facilitate data collection, the Souhegan River was divided into ten segments according to natural landmarks. SWA members and additional volunteers then carried out the data collection by either walking or canoeing the shoreline. The data and final report was then assembled by NRPC. Only a small percentage of the river was not surveyed.

Souhegan River Survey Segments

Segment 1: Confluence of the south and west branches of the Souhegan River to the beginning of Waterloom Pond.

Segment 2: Beginning of Waterloom Pond to the outlet of Waterloom Pond

Segment 3: Waterloom Pond outlet to confluence of Furnace Brook

Segment 4: Confluence of Furnace Brook to the New Ipswich/Greenville Town Line

Segment 5 Old Wilton Road (Green Bridge in Greenville) to the First Label Art Dam in Wilton

Segment 6: Stony Brook in Wilton to the Green Bridge (on Rte. 101) in Milford

Segment 7 Souhegan Street in Milford to the Seavern's Bridge in Merrimack

Segment 8 Seavern's Bridge to the Turkey Hill Bridge

Segment 9: Weston Park at Turkey Hill Bridge to the Everett Turnpike Bridge

Segment 10: Everett Turnpike Bridge to the Merrimack River at the railroad bridge

Project History of Water Quality Monitoring

The Souhegan and Merrimack River Water Monitoring Project began in 1991 under the direction of the Nashua Regional Planning Commission (NRPC), and was sponsored in the following years (1992-1995) by the MRWC with guidance from River Watch Network (RWN), and funding from the Merrimack River Initiative. Technical assistance and laboratory work during this period was provided by Rivier College, the Merrimack Wastewater treatment Facility, the U.S. Fish and Wildlife Nashua National Fish Hatchery and the NHDES.

In 1996, the SWA and the Lower Merrimack River Local Advisory Committee (LMRLAC) joined to continue monitoring efforts on the Souhegan and Merrimack Rivers. Funding was obtained and volunteers for the 1997 season resumed monitoring. Results from the previous years are available in the Nashua Area Summary Report, 1991-1995 published by the MRWC and the Souhegan and Merrimack Rivers Water Monitoring Project, 1997and 1998 Reports, published by the SWA and LMRLAC. All are available from local libraries and conservation commissions as well as through the SWA, MRWC and the NRPC.

Funding for the 1998 season was obtained through a NHDES Non-Point Source Pollution Grant as a result of a proposal submitted by the SWA and LMRLAC. Additionally, the MRWC Volunteer Environmental Monitoring Network (VEMN) generously provided the use of some supplies. Local laboratories in the Greenville, Milford, Merrimack and Nashua Wastewater Treatment Facilities and the National Fish Hatchery in Nashua donated their services for the project.

Greenville Milford, Merrimack and Nashua Wastewater Treatment Facilities continued to provide volunteer laboratory support during the 1999 monitoring season, as did the National Fish Hatchery in Nashua. In addition, funding for total phosphorus analysis was provided through the Volunteer River Assessment Program (VRAP) at the NH Department of Environmental Services.

Since the beginning of the monitoring season in 1991, there has been a gradual increase in the number of sampling sites monitored as well as an effort to maintain consistency from year to year for the purpose of seeing long term trends in the rivers health. Although both the Souhegan and Lower Merrimack Rivers have proven to be in overall good health for the parameters tested, there have been several areas, which have consistently exceeded state standards from year to year. On the Souhegan River, impact sites monitored in the downtown areas of both Wilton and Milford have consistently exceeded state standards for E.coli bacteria, in particular the Swing Bridge Site in downtown Milford. Several more rural sites in the Amherst area have also exceeded E.coli over the years tested. These sites are located in the area of the Amherst Country Club and downstream to the Boston Post Road Canoe port.

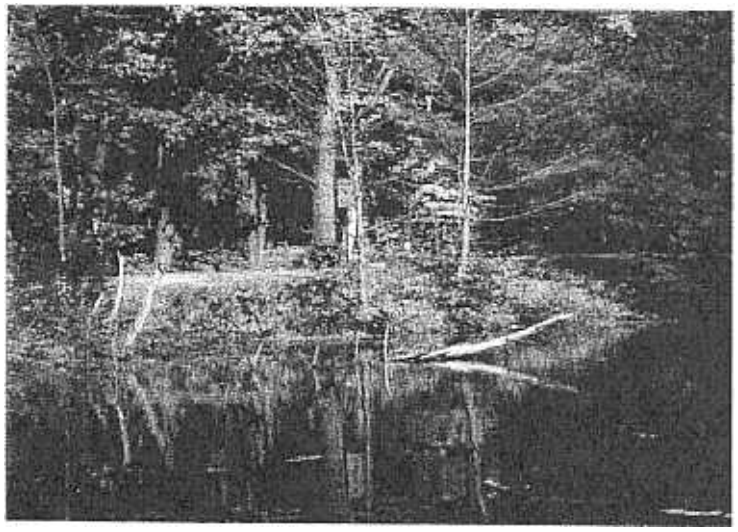
Although total Phosphorus has not been monitored as consistently as other parameters, several problem areas have been identified including the impact sites for both the Milford and Greenville Wastewater Treatment Plants on the Souhegan River and the impact site for the Amherst Country Club and Boston Post Road Canoe port. Sites tested throughout the town of Merrimack also tested higher than acceptable for Total Phosphorus.

Narrative Descriptions of Shoreline Survey Segments

Segment 1: Confluence of the south and west branches of the Souhegan to the beginning of Waterloom Pond.

Observers: Sam Mathews and Nat Ober

This stretch of the Souhegan ranges from a shady stream, canopied by hardwoods and softwoods, out to the beginnings of Waterloom Pond. The current is lazy and aquatic grasses are predominant in the stream. The water is clear and it is possible to see sunken trees as you float over them. Only a thin screen of trees separates the river from River Road. The atmosphere is idyllic, with little evidence of the intrusion of man. It is tempting to improve access to the area so others can enjoy it. However, there is a distinct possibility that increased visitation would ruin the sense of peace.



River Road parallels Waterloom Pond

Segment 2: Beginning of Waterloom Pond to the outlet of Waterloom Pond.

Observers: Don Bartlett and Bob Boynton

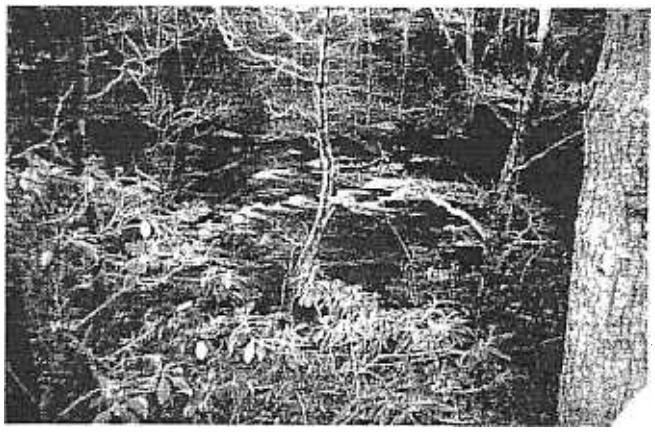
Normally this section flows very slowly with no notable current. Pond width varies from several hundred to over 1,000 feet. The eastern shore is primarily undeveloped. A large section of this area has recently undergone timber harvesting. Several homes are located on this bank. The vegetation is intact with the exception of a 50-foot beach. The beach has a very shallow gradient with a small amount of erosion. A bridge and a road segment the pond. Erosion is very evident from the roadway. A culvert along the dirt road has been dug which increases erosion on the streambank. Aquatic vegetation increases between the bridge and the dam. The western bank begins with a large area of healthy wetlands that is bisected by River Road. The shore vegetative buffer is almost completely intact. There is one very distinct erosion problem on this shore. During 1995 a home foundation was dug approximately 50 feet from the shore. The shoreline vegetation was removed for about 150 feet resulting in severe erosion problems. The shoreline remains intact until it once again abuts River Road where minor problems are evident. The shoreline is undeveloped with the exception of several homes between the bridge and the dam. No obvious problems in this section except increased aquatic vegetation.

Segment 3: Waterloom Pond outlet to confluence of Furnace Brook

Observers: Karen Simms and Tom Quarles

The first half, from the Pond to Highbridge at Route 124, runs along River Road and is residential in character. It is marked by numerous riffles and mild rapids, several small islands in the middle of the river, and steeply sloping banks along much of the stretch. The stream is about 10-15 feet wide in most spots along this part. The banks are vegetated, with a predominance of mountain laurel.

There is evidence of an old dam or mill, with stonework on the riverbanks at a set of natural ledges in the stream. There is evidence of two or three old fords and an old road alongside the stream, part of which appears to have been recently used. On the steeply sloping banks at two or three points there is an accumulation of old trash, mattresses, appliances and the like, along with a great deal of broken glass. This is somewhat hidden by leaves and brush. The stream itself is remarkably clean of trash and debris. The stream banks become a deep gorge as the river approaches Highbridge at Route 124, a beautiful old stonework bridge, which has a single arched opening through which the water flows sluggishly. A little way before Highbridge, a major feeder stream, marked but unnamed on the map, tumbles into the Souhegan over rock ledges, pools, and a small waterfall.



Mountain Laurel along the banks of the river

Past Highbridge, the steeply sloping banks continue for awhile. Warwick Mills with its dam is sited near the intersection of Route 124 and the river. Over the dam the water drops approximately 25 feet. Just below the dam, Mill Street runs parallel to the river and provides access to the trailhead for the Furnace Brook Trail (NICC). The trail, on a conservation easement, follows the Souhegan before picking up Furnace Brook. Below the dam, the river continues to drop through a gorge until a five-foot drop over rocky ledges and a large pool below. At this point the river widens to about 25 feet and the flow moderates, then becomes slow. A little way down, the river splits into two channels around a large, thickly vegetated island (barberry and wild grape among the vegetation). The main channel narrows to about 10 feet wide and 1-2 feet deep and the water flow picks up with some rapids. The flow slows again just before the side channel rejoins the main channel. After this, the river widens and deepens to about 20 feet wide and 3-4 feet deep. There is a ford and a footbridge over the river. The land around this area is in agricultural use. Shortly after the channels rejoin, one reaches the confluence of the Souhegan River and Furnace Brook, in a densely vegetated section.

Segment 4: Confluence of Furnace Brook to the New Ipswich/Greenville Town Line

Observers: Karen Simms and Tom Quarles

Just after Furnace Brook joins the river, the thick vegetation opens up into a hay field for a short stretch and the river is about 15 feet wide and 2 feet deep with moderate flow. The river then narrows to about 10 feet amid beech bushes on the shore. There are riffles and a ford and a moderate to quick flow continues for awhile. Then the vegetation becomes thick again, and the stream banks steeper. The depth along this stretch is about a foot, sometimes less. The bottom is sandy with cobbles. The river widens again to 20-25 feet wide. Flow continues to be moderate to quick. There is hemlock and mountain laurel on steep banks, and moderate bank erosion. A striking feature of this segment is a very large, glacial erratic, about 20 feet high on the bank. Smaller boulders are scattered in the river nearby. Past this, the river gets gradually deeper, eventually becoming 3-5 feet deep with slow flow. An old stone wall is seen on the steep bank. There is a section where the bank is mostly clear of vegetation and the water becomes 5-10 feet deep. Some erosion and trash from Route 123, which runs parallel to the river, is evident. The river

widens still more, to about 30 feet wide, with wetlands along the banks near where a large, unnamed tributary joins the river. Shortly after this is the New Ipswich/Greenville border.

Segment 5: Old Wilton Road (Green Bridge in Greenville) to the First Label Art Dam in Wilton

Observers: John Vogl, George May and Curt Schnare

From Old Wilton Road to the gorge the river is flatwater with highly vegetated banks. The stretch from the Greenville gorge, the site of a hydroelectric dam that has been removed, to the Route 31 bridge is forested with maples, firs, and mountain laurel. There is no development. At times of high water, this is a Class 3 canoeing stretch. There are many large boulders in and along the river. There are several ledges exposed by the river. There is shisty, metamorphic rock evident throughout. Several very steep rock cliffs were noted along the north side of the river. This section averages 30-40 feet in width. Although Route 31 comes close to the south side of the river, it is never visible through the riparian buffer.

The Route 31 bridge to the new Route 101 bridge is classified as a Class 2 canoeing stretch and is heavily used in the spring. There were a number of trees in the river, none of which completely blocked the river but several could be a safety hazard to inexperienced canoeists. The Merrimack Valley Paddlers and Appalachian Mountain Club usually clear the river of boating obstacles. The riverbanks are less steep and the boulders are smaller than in the section above. The river averages 50-60feet wide with several small islands. The river is shallower and the flow is slower. There is a sandpit on the north side of Route 31 visible from the river. It does not appear to be active, but there has been some recent activity along the roadside. There has been some severe clearcutting along the south side of the river probably across from the Wilton Town Forest. Monadnock Spring Water has parking lots right to the edge of the river. There is considerable trash from the business along the bank and a nasty looking swale behind the first parking lot. There are several houses with lawns (one with a pipe) that come all the way to the river just upstream of the old Route 101 bridge.

The segment from the Route 101 bridge to the first Label Art Dam is Class 3 and has the largest rapid on the river at the Horseshoe, a gorge with 30 foot cliffs on both sides. This is a popular swimming hole during the summer. The average width throughout this segment is 60-70 feet. The Wilton Recycling Center on the south side of the river has a lot of trash of all kinds along the steep bank. The Center is visible from the river despite the steep bank. Several houses are visible on the steep north bank just below the Horseshoe.

From the Label Art Dam to Stony Brook the river continues much as above in Class 2/3 rapids. There are houses all along the right side of the river as it gets closer to downtown. The river flows under the Route 31 bridge and Stony Brook enters on the left.. It comes over a 20-foot dam and the Souhegan makes a hard right turn. At this point the river is ponded up by the next downstream dam. All along the right side of the river is the Label Art parking lot. There is riprap to the edge of the parking lot and little or no vegetation.

Segment 6: Stony Brook in Wilton to the Green Bridge (on Rte. 101) in Milford

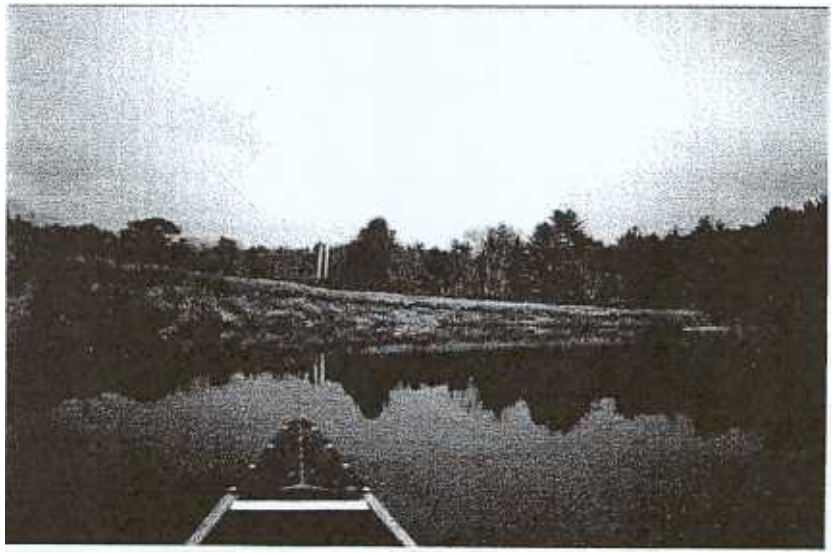
Observers: Curt Schnare

There are three dams and one weir in this segment of the river. The overall condition is rated good with the exception of some erosion and trash in spots. It was noted that sudsy foam was discharged behind Souhegan Wood Products. Another problem area is household trash and junk behind a house in Wilton. The dirt road by the hydro plant has some erosion problems. There are plenty of informal access points throughout this section because of the close proximity of the road. The water depth and flow varies considerably throughout this segment. It should be noted that the large field across from the Ram in the Thicket restaurant would be a good candidate for an agricultural or conservation easement.

Segment 7: Souhegan Street in Milford to the Seavern's Bridge in Merrimack

Observers: Steve Campbell, Moira Gagnon, Rich Hart, and Anne Krantz

The segment consists of a wide variety of land use types. Commercial, agriculture, residential, golf course and a wastewater treatment plant can all be found here. Despite all the uses approximately 40% of the banks are shaded. There were quite a few pools and riffles throughout this section of the river. It should be noted that the river was observed three days after Hurricane Floyd dumped 7 inches of rain the area. The river was higher than it has been since the spring snow melt. The river was flat through the entire town of Amherst so there were no rapids or white water. There was a good current and the surveyors floated over rocks, limbs, and other obstructions. The water was tea colored and the bottom could not be seen. Only when paddling through one of the large oxbows was the water clear enough to see the sandy bottom. Maybe one or two large trees had been



Typical stream bank erosion through Amherst and Merrimack

undermined enough by the high water to now be falling into the river. Erosion along sandy bluffs seemed natural. Although the water level was very high, several irrigation pipes were noted and marked on a map. In several sections there were residential lawns right up to the edge of the river: above Boston Post Road and behind Souhegan High School. There was a lack of buffers in some areas along the Amherst Country Club. During the summer algal blooms were noted by the

Souhegan Woods Golf Course. The shade along the river was approximately 75% and rated good overall. There are many large tracts along the river in Amherst and would be worth pursuing for conservation/recreation easements.

Segment 8: Seavern's Bridge to the Turkey Hill Bridge

Observers: Gary Gagne

This segment is approximately three and one-half miles long. It was noted that a road drainage pipe runs almost directly into the river below the bridge. Some erosion and lawn clippings were also found on the west bank. The banks are primarily vegetated with softwoods, with some signs of clearing beyond the bordering trees on the west bank. There is also one small cut on the east bank which extends right to the river for a length of about twenty yards, however, this stretch does not exhibit any particular erosion problems. Another straight reach ends at a cut bank on a sharp meander to the east. Again there are signs of clearing on the west bank, but the banks are vegetated with softwoods and grasses. There are no real erosion problems seen, except on the cut bank. The river then briefly extends to the east before turning slightly more to the north. In this short segment, the river begins to quicken, and becomes shallower, with both, but particularly the south bank becoming considerably steeper. Rapids can be seen on the east bank. Throughout this section, a footpath can be seen running along the east bank. There is also a woods road network that parallels the river as well as away from the river in several places. Some erosion can be observed along this road, but the distance away from the river seems to preclude much sediment from being washed into the river.

The Indian Ledges are two series of drops (ledges), the first of which flows into a pool before descending into a second set of rapids through three channels and around two islands. The far right channel exhibits flow only during high water periods. There are extensive amounts of snags and outwash at the end of the first pool. Near the end of Indian Ledges, the river turns again to the east where the flow slackens, and the river turns to the north before one more set of rapids. Indian Ledges is accessible from Davidson Road and while fairly clean during this recent visit, has seen problems with trash, graffiti, and campfires from night time activities there in the past. Below the Ledges a large mass of drift is on the south bank and there are small erosion problems. An informal

Indian Ledges

target range was observed on the north. Throughout the rest of this segment, softwoods become less prevalent along the banks, replaced primarily by oak and maple. Extensive meandering results in many actively eroding cut banks, and the stream bottom is exclusively sand. Only two houses are close enough to the river in this stretch to be noticeable, though other development is visible along the north bank. The first home is situated above a cut bank, but does not present any obvious erosion problems. Another typical meander/cutback and snag are downstream. The other homesite has riprap on a small portion of the bank. There are three or four similar spots with riprap downstream. Cut banks have extensive swallow nesting activity in season. The Turkey Hill Bridge does exhibit some signs of erosion from its road footings, and as with Seavern's Bridge, does have at least two road drainage pipes discharging almost directly into the river.

In general, I would characterize this segment as suffering from a sort of benign neglect; there are no major impacts, and many signs of wildlife. There is evidence of burrowing, raccoon and muskrat sign, seen or heard birds of prey, and I once floated under a great horned own perched in a tree overhanging the river. Small immature fish, great-blue herons, and ducks have been observed over the last seven years. However, there are visible signs of logging, riprap, and purple loosestrife in the wetland adjacent to Turkey Hill Bridge. Trash is evident in many reaches, particularly behind snags, and so the impression becomes one of an important natural resource that supports many functions, but is not recognized or protected as such.

Segment 9: Weston Park at Turkey Hill Bridge to the Everett Turnpike Bridge

Observers: George May

There is a riffle area below the Turkey Hill Bridge; a riffle rapid and another annoyingly shallow rapid about half way down; and from Wildcat Falls on down is mostly heavy rapids. The rapid areas are made up of boulders or bedrock. Otherwise the river bottom is sand over much of the section. The depth varies from fairly shallow with a sand bottom to very deep near the rapids. There are a few small sand islands. For most of its length there are steep eroding banks that go up at least six feet to a flat terrace. In a number of sections the bank goes up 50-60'. There are quite a few houses visible from the river on both sides. There are several that have lawns that come right to the edge of the bank and have steps or access to the river. Mostly the banks are very steep and not easily accessible.

Trees of mixed varieties of hardwood and pine overhang the banks all along. There are some fallen trees in the river along the shore but none that impede a canoe. The river ranges from 60' to 120' wide. Wildcat Falls is impassable for all but expert kayakers but the rest of this section is suitable for beginners. Canoes should note the power lines that cross the river from the DPW to the 80 Acres Park and take out there at the DPW on the right. People can scout Wildcat Falls by taking out on the 80 Acres side and following well worn trails to the falls. There are additional canoeable rapids below Wildcat Falls to the Merrill's Marauders Bridge on the Everett Turnpike but they are short and not worth a portage. After the bridge the water is ponded by the dam on Rte 3 near the fire station. The river joins the Merrimack River a short distance beyond the dam. There is no fish passage on this dam.

There are several places where landowners have tried to control erosion - one (tan house on river left one corner above the middle rapid) has placed sandbags on an almost vertical 20' bank. Some of the bags are gone and I presume in the river. He has a chainlink fence at the top of the bank.

Just above Wildcat Falls on river right there are many converted cottages on tiny lots and several have dumped fill over the bank to increase or flatten their property. A gray house with an extensive deck and steps goes right into the river and the house next to it has dumped fill over the bank to the river. I didn't notice any severe pollution problems along this stretch, but landowners trying to control erosion or dumping fill bears watching and education.

Rocks, rapids, and islands are typical of this segment

There are a number of natural sandy beaches. The one on river right just below Wildcat Falls is very large, but there is a house right there and it looks like they've appropriated it. There are trails along both sides of the river. A number of hikers and bikers were seen on the trails at 80 Acres Park.

Segment 10: Everett Turnpike Bridge to the Merrimack River at the railroad bridge

Observers: George May and Ernie Thibault

This stretch of the Souhegan can be broken into two sections - one between the turnpike bridge and DW Highway bridge and the second below the DW Highway bridge to the meeting with the Merrimack River. The entire segment is in a very populated area, the demographic center of Merrimack. The river runs under the turnpike bridge (which is scheduled for reconstruction that may allow needed pedestrian passage along the river), over rapids into an impoundment, behind a mall, past the central fire station, over a dam, over more rapids, under the DW bridge, past Harcross Chemical, past the mouth of Baboosic Brook, under a railroad bridge, past the old Jones Chemical buildings, and into the Merrimack River.

There are trails along river right the entire length of the segment. The area begs becoming a public park. There is interest in the town for this. The area above the dam is generally cleared and quite scenic. There are rocks and rapids near the turnpike bridge and a very small island and wetland on the right. The banks here are very steep that taper down to open flat land at the impoundment. There are two small sand islands within the impoundment. This section is behind the mall which is not visible from the river.

The river flows over a 20-30' dam that is controlled by Pennichuck Waterworks but has no present use. The land on the left is the location of the central fire station. Their parking lot overlooks the dam. It then flows over rapids under the DW bridge. All of the area on the left between the DW

bridge and Baboosic Brook has a steep, built up bank owned by Harcross Chemical. There are several pipes coming from this property. They appear to be drainage pipes. One had an outflow during dry weather.

The river right below the dam has extensive trails along the river behind the several houses along the DW Highway. Steep banks separate these houses from the vacant land. There is a wetland in this area and a lot of piles of debris dumped when the factory that was Jones Chemical was a leather shop.

The entire segment is surprisingly free of development considering its location. It would make an important public park that might also allow access to the 80-Acre Conservation Area and to the high school property.

Results of the 1999 Shoreline Survey

Segment Number & Location	Problems	Assets	Priorities for Action
1. South & West forks to Whirlpool Pond in New Ipswich	None observed	Overall segment is undeveloped and in excellent condition. Trails and easements could be established-east	Pursue conservation easements
2. Inlet of to pond to the outlet in New Ipswich	Erosion from Connty Rd., the bridge, and 1995 construction on the west bank	Overall segment is undeveloped and in good condition. Excellent wildlife habitat and recreational potential.	Erosion control and future conservation easements.
3. Outlet of pond to Furnace Brook in New Ipswich	Trash is the biggest – two dumps	Overall segment is rated good. There is a conservation easement and the Furnace Brook Trail nearby.	Clean up dump sights with DPW assistance.
4. Furnace Brook to Greenville Town Line	Several trashy areas and erosion on Route 123	Overall segment is rated good. Large glacial erratic on north bank.	DPW to check road erosion. Annual cleanup list.
5. Old Wilton Rd. in Greenville to Stony Brook in Wilton	Trash at Monadnock Water and recycling center. Trees blocking river below Rt. 31.	Overall segment is rated excellent. Many trails along Rt. 31. Largest rapid on the river.	Trash cleanup. Monitor and educate landowners. Remove trees from river.
6. Stony Brook to the Green Bridge in Milford	Sudsy foam behind Souhegan Wood Products. Erosion by hydro plant	Overall segment is rated good. Access points due to proximity of road. Large undeveloped field.	Pursue easement in field across from Ram in the Thicket Restaurant.
7. Souhegan St. in Milford to Seavern's Bridge in Merrimack	Algal blooms and lack of buffers by golf course. Residential lawns.	Overall segment is rated good. Rare and endangered wild senna. Large open fields in the floodplain.	Monitor Souhegan Woods Golf Course. Pursue conservation easements.
8. Seavern's Bridge to Turkey Hill Bridge in Merrimack	Degraded wetlands by Turkey Hill Bridge. Snags and trash below Indian Ledges.	Overall the segment is rated good. Diverse species habitat. Several swimming holes and footpaths.	Investigate drainage pipes and erosion at the bridges. Annual cleanup at Ledges.
9. Turkey Hill Bridge to Everett Turnpike Bridge	Fill and lawns right to the river.	Overall the segment rated excellent. Sandy beaches and hiking trail along the river. 80-acre park abuts river.	Homeowner education of lawns and erosion control.
10. Everett Turnpike to the Merrimack River	Dumping at Jones Chemical. Possible drainage pipe problem at Harcross Chemical. Drainage ditch from gas station above dam.	Trails along entire segment. Free of development considering location. Access to 80-acre park and undeveloped high school property.	Pursue easements to create a public park and create a trail system. Test gas drainage ditch by dam-monitor.

RESULTS OF PIPE SURVEY

Segment #	Pipe #	Date	Weather Today	Weather in Last 24 Hours	Pipe Material and Condition	Pipe Size Flow Rate	Comments
1		10/17	Clear sunny	Clear	No pipes		
2		11/27	Cloudy	Rain	No pipes		
3		11/24	Mostly sunny	Rain/clearing	No pipes		
4		11/24	Mostly sunny	Rain/clearing	No pipes		
5	1	9/17	Clear	Heavy rains	PVC 8"	Nothing	Filthy swale behind Monadnock Spring Water
	2	9/17	Clear	Heavy rains	PVC 6"	Nothing	Upstream Rt. 101 bridge landowner education -lawns
6	3	11/27	Sunny and cool	Sprinkles		Nothing	
6	4	11/27	Sunny and cool	Sprinkles	Rock wall - 2 pipes	Nothing	
6	5	11/27	Sunny and cool	Sprinkles	Rock wall culvert	Dry	
6	6	11/27	Sunny and cool	Sprinkles	P V C white	Dry	
6	7	11/27	Sunny and cool	Sprinkles	2 Pipes in rockwall	Dry	
6	8	11/27	Sunny and cool	Sprinkles	Swale	Min. flow	Behind Souhegan Wood Products
6	9	11/27	Sunny and cool	Sprinkles	concrete	Mod. Flow	Small brook
6	10	11/27	Sunny and cool	Sprinkles	Crushed Steel	No flow	
6	11	11/27	Sunny and cool	Sprinkles	Concrete	No flow	
6	12	11/27	Sunny and cool	Sprinkles		Min. flow	
6	13	11/27	Sunny and cool	Sprinkles	Steel	Min. flow 24"	
6	14	11/27	Sunny and cool	Sprinkles	10 pipes granite wall		
6	15	11/27	Sunny and cool	Sprinkles	Concrete culvert w/sluiceway	Fast Flow 10'	
6	16	11/27	Sunny and cool	Sprinkles	PVC Pipe from house	No flow Drywell ?	
6	17	11/27	Sunny and cool	Sprinkles	Drain culvert	No flow 24"	
7	18	9/20	Sunny		Concrete	No flow	
7	19	9/20	Sunny		Concrete		River is 1/2 way up pipe
8	20	10/30	Clear 50's	Clear	2 road drains	No flow	Seavern's Bridge

Segment #	Pipe #	Date	Weather Today	Weather in Last 24 Hours	Pipe Material and Condition	Pipe Size Flow Rate	Comments
8	21	10/30	Clear 50's	Clear			Turkey Hill
9	22	10/16	Sunny and clear	Sunny and clear	2 Concrete	No flow	Cota Road
9	23	10/16	Sunny and clear	Sunny and clear	Corrugated steel	18" No flow	Bottom section broken off/Hole in Bank/Report to DPW.
9	24	10/16	Sunny and clear	Sunny and clear	Concrete	No flow 24"	Across from 80 acre park
10	25	10/22	Partly cloudy 40-60		Iron	8"	Old USGS Gaging Station
10	26	10/22	Partly cloudy 40-60		Concrete	24" /2" Flow	50' apart starting 50' from D.W. Hwy. Bridge
10	27-29	10/22	Partly cloudy 40-60		3 Concrete	24" Now flow	North side above Baboosic Brook

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